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NOTES ON A NEVADA SHELL (PYRGULA NEVADENSIS).

BY R. ELLSWORTH CALL AND C. E. BEECHER.

THIS form was described by Dr. R. E. C. Stearns[1] from material furnished in part by one of the present writers. The description was based upon the external characters presented by the shell alone, for at that time material containing soft parts had not been discovered. Since the printing of the description opportunities were afforded us to make extensive collections of recent and Quaternary shells in the Great Basin, and the biologic and climatologic results of our study are now being formulated for publication under the auspices of the United States Geological Survey.

The examinations made along the south and west shores of Pyramid lake, Nevada, demonstrated the existence of this form, Pyrgula, in countless thousands in that remarkable body of water. At a single locality more than a gallon was obtained, associated with many hundreds of *Pompholyx effusa* Lea, and many *Physa humerosa* Gould. From this material a large number of specimens, containing the dried animals, was assorted and sent to Mr. Beecher, who has successfully worked out the dentition, and described it as below;[2]

The genus Pyrgula has not received a uniform treatment at the hands of systematists, none of whom have yet studied the denti-

[1] Proc. Phila. Acad., 1883, pp. 171–176, with figure.

[2] Mr. Beecher is alone responsible for the dentition as here given. His work is most careful and painstaking, and we hope jointly to present, in the course of time, very much more of his careful work in dentitions.

tion, and most of whom have never seen even the shell. Nearly or quite all who have based their opinions upon actual study of shells, have been obliged to content themselves with such external characters as the shells furnish, and these are often most unsatisfactory. Pyrgula is operculated, carinated, and with the spire well elevated, thus presenting features which might excuse a reference of it to the Melaniidæ, which has been actually made by most authors. Until the work of Stimpson[1] on the Rissoidæ the genus appears to have been placed in some most remarkable positions. At that time nothing was known except the obvious characters furnished by the test, and some observations by Moquin-Tandon on the form common to the rivers of the mountainous portions of France,—*P. bicarinata* Bourg.

In the system here provisionally adopted from Stimpson,[2] Pyrgula lies between Paludestrina and Tryonia, having superficial characters intermediate to those genera. Dr. W. H. Dall has suggested, in a recent letter, that possibly the Pyramid lake shell would be found to rank in Amnicola, basing his opinion upon the operculum, which certainly possesses some Amnicoloid characters, and upon the produced anterior part of the aperture, as mentioned in the generic description by Christoforo and Jan. But now the work of Mr. Beecher for the first time enables us to correctly place it among the Rissoidæ. My collaborator has made no comparisons with figures resulting from the work of others, and I hence introduce here a few notes based upon the observations of Troschel, Moquin-Tandon, Stimpson and myself.

The formula for the rhachidian tooth of the genus Amnicola is $\frac{3.1.3}{4.1.4}$. The tooth itself is about three times broader than high (Fig. 6), has a greater number of basal denticles than the corresponding tooth of Pyrgula; the formula for that genus being $\frac{4.1.4}{1.1}$. The peculiar tongue-shaped process of this tooth in Amnicola is entirely wanting in Pyrgula, and the lateral lobes are more denticulate. Paludestrina has a similar formula for the rhachidian tooth—$\frac{4.1.4}{1.1}$—but differs in other important particulars.

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Rhachidian tooth of *Amnicola porata* Say. Enlarged from Stimpson.

[1] "Researches on the Hydrobiinæ and allied forms." Smithsonian Misc. Coll., No. 201, 1865.

[2] *Loc. cit.*, p. 47.

Comparing these formulæ, the necessity of complete separation from Amnicola is sufficiently obvious. Whether the produced aperture of Pyrgula, as figured by Chenu,[1] is of generic value is quite uncertain, for Pyrgula is most certainly a vegetarian. Though the genus is said to be confined to the fresh waters of the mountainous areas which it inhabits, it is, in the North American localities, found in brackish water-lakes alone.

It may profitably be further noted that the dentitions given by Troschel, Moquin-Tandon and Stimpson differ very much, even more than should be allowed to pass without comment. It has been found by Mr. Beecher, and corroborated by the senior author, that many descriptions are imperfect and will need revision. To this end we invite collectors to send to our addresses any of the smaller species of fresh-water univalves which may chance to occur in their localities.[2]

Following is the description of

THE DENTITION OF PYRGULA NEVADENSIS.

Jaw thin, membranaceous.

Odontopore .62^{mm} in length, and .15^{mm} in width. There are usually fifty-five transverse rows of teeth, arranged according to the formula 3–1–3, which is common to the family Rissoidæ.

Rachis distinct, occupying one-fourth the width of the ribbon. Rhachidian tooth (Fig. 1) short and broad, with the infero-lateral angles produced and slightly arcuate. On each side of the anterior face is a strong, short, conical process or basal tooth projecting outwards and somewhat downwards. Basal margin trilobate; central lobe truncate. Cusp curved forwards and extended into a strong denticle with four smaller ones on each side. The formula of the denticles for this tooth would therefore be $\frac{4+1+4}{1+1}$.

Body of intermediate tooth (Fig. 2) subrhomboidal, with the infero-interior angle slightly produced and with an angulation in the margin above. From this point there is a thickening or ridge extending towards the fixed end. Peduncle longer than the body of the tooth. Upper margin abruptly curved forwards and marked by seven denticles, of which the third inner one is usually the largest; the formula for this tooth may be written $2 + 1 + 4$.

Inner lateral tooth (Fig. 3) spoon-shaped, with the infero-interior margin angular. Upper anterior margin marked with a fringe of about twenty-four denticles decreasing in length from the inner extremity. Peduncle straight, wider than the body.

Outer lateral tooth (Fig. 4) falciform, straight along the peduncle. Anterior margin and extremity denticulated with thirty minute denticles, usually decreasing in length towards the distal extremity, but subject to some variation. The denticulate margin extends more than one-third the length of the tooth. Peduncle slender and nearly straight.

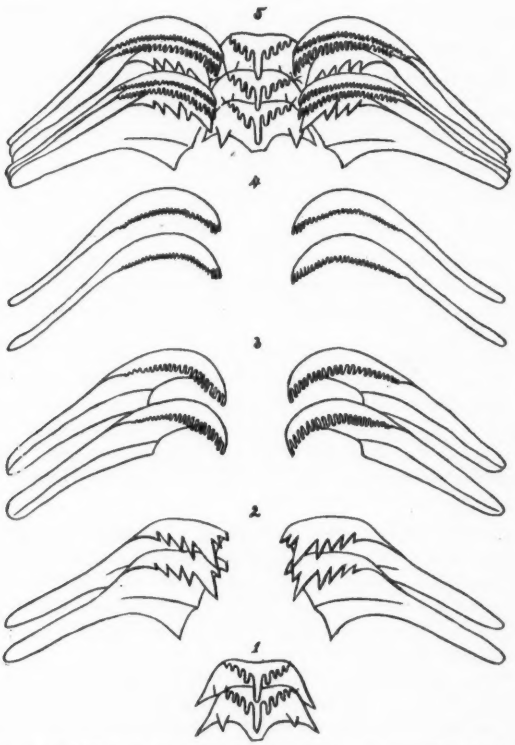
[1] Manuel de Conchyliologie, Tome I, 294, Fig. 2029.

[2] R. Ellsworth Call, Des Moines, Iowa, or to C. E. Beecher, 273 Hudson ave., Albany, N. Y.

The formula for the denticles is $30\text{–}24\text{–}7\text{–}\frac{4+1+4}{1+1}\text{–}7\text{–}24\text{–}30$.

There is a marked variation in the character of the denticles on the intermediate and lateral teeth. On the intermediate they are large, angular and somewhat irregular. The lateral teeth are uniformly marked by a regular fringe of slender denticles, which are much smaller on the outer lateral.

Some portions of the membrane and different specimens show considerable variation in the length and strength of the denticles on the lateral teeth, and sometimes their number seems subject to some mutation. The numbers given in the formulæ were averaged from several enumerations, and represent the comparative denticulation of the teeth.



Lingual dentition of *Pyrgula nevadensis* Stm., × 500 (Beecher).

DESCRIPTIONS OF FIGURES.

FIG. 1.—Rhachidian teeth.

FIG. 2.—Intermediate teeth.

FIG. 3.—Inner laterals.

FIG. 4.—Outer laterals.

FIG. 5.—A portion of the odontophore representing the teeth in their natural position. All enlarged to 500 diameters.

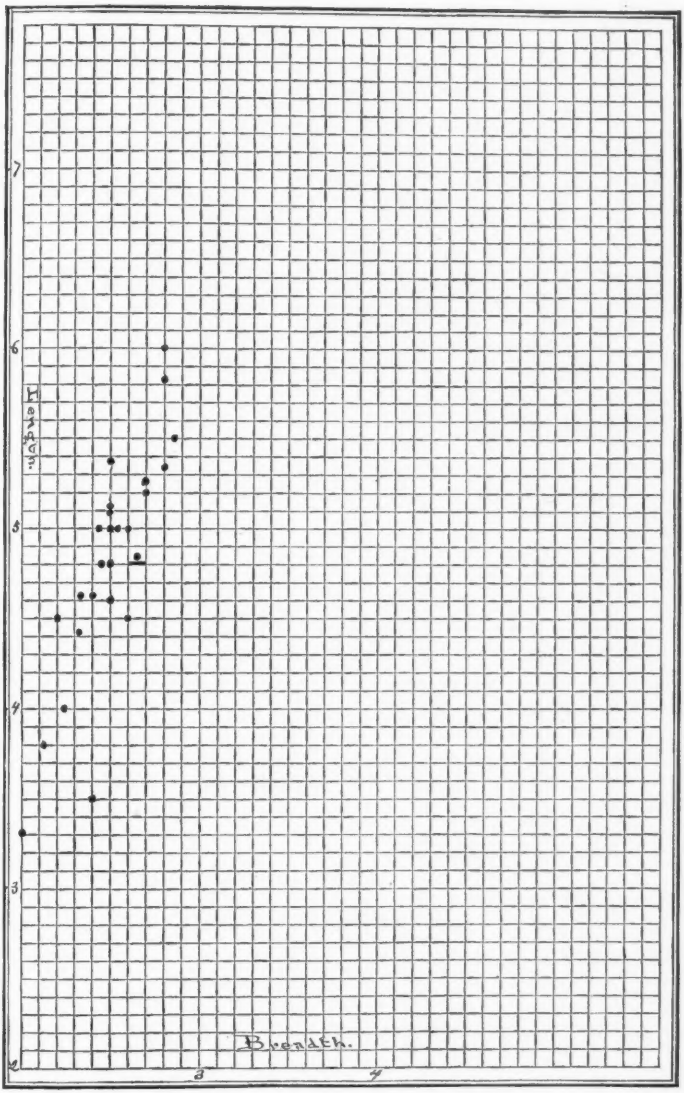


Chart showing Variations of Pyrgula nevadensis. (Each dot represents a shell.)

Pyrgula nevadensis varies in size within rather wide limits. Twenty-five specimens, taken at random, present the following averages: Length 4.83^{mm}; breadth 2.65^{mm}. These proportions are best shown graphically, as are also the extremes of variation, by the accompanying plate, XXV, in which 2^{mm} is adopted as the origin of the coördinates. Each small square represent a $.10^{mm}$. The dot underlined represents the *average* of the specimens measured. At some future time more complete notes on this species, and on those inhabiting the salt springs and lakes of the Great Basin, from a biological standpoint, will be presented the readers of the NATURALIST.

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ASPECTS OF THE BODY IN VERTEBRATES AND ARTHROPODS.

BY A. S. PACKARD.

UNDER the title "Aspects of the Body in Vertebrates and Invertebrates" (London, 1883), the venerable and distinguished English anatomist and palæontologist, Professor Sir Richard Owen, renews in a vigorous way the old discussion originally begun by Geoffroy St. Hilaire. The view in question is tersely presented in St. Hilaire's answer to Dugès, quoted by Professor Owen, when he replied by reference to "Fig. 2 de la septième planche: Là se trouve effectivement représenté un homard couché sur le dos et montrant distinctivement ses viscères dans la position où le sont les viscères des mamifères placés sur le ventre." This view was combatted by Cuvier, and in this respect he has been followed by Gegenbaur.

In his able essay Professor Owen places himself on the side of St. Hilaire, and the special point in vertebrate anatomy which he brings forward to support this opinion is the homology of the conario-hypophysial tract, which he regards as "the modified homologue of the mouth and gullet of invertebrates;" and at the end of chapter I he concludes that "the surfaces or aspects of the body which are truly homologous in the snake and caterpillar are the *neural* and the *hæmal*, not the *dorsal* and the *ventral*."

In his second chapter, entitled "Cerebral homologies in vertebrates and invertebrates," Professor Owen quotes our statement[1]

[1] Second report U. S. Entomological Commission. Chapter XI. The brain of the Locust, p. 224. 1880.

that "the brain and nervous cord of the fish or man is fundamentally different, or not homologous with that of the lower or invertebrate animals;" and then proceeds to criticize it.

The chapter on the brain of the locust was written for the unscientific as well as the scientific reader, and the introductory part was presented in a terse, perhaps dogmatic way, for the sake of clearness.

The author, without taking time and space to discuss at length this broad question, which requires a far wider acquaintance with anatomy and embryology than he claims to possess, would beg leave to briefly present some facts and considerations which seem to him to support the view he adopted as to the lack of homology between the nervous system of arthropods and vertebrates.

These facts relate to the histology and the histological topography as well as general morphology of the system in question, and the general relation of the viscera to the body-walls of arthropods as compared with vertebrates.

1. *Histology.*—There are but two histological elements in the brain and spinal cord of vertebrates, *i. e.*, ganglion-cells and nerve-fibers proceeding from them. In worms (and mollusks so far as known) and especially in the brain (procerebrum, as we may call it to distinguish it from the cerebrum of vertebrates) and other ganglia of Crustacea and insects, besides these two elements there is a third substance, the *punktsubstanz*, discovered by Leydig, and farther described by Dietl and Krieger, and for which we would suggest an English equivalent, the *myeloid substance.*

2. *Histological topography.*—The arrangement of the ganglion-cells and other tissues in the ganglia of arthropods is not homologous with that of vertebrates. In the brain or any of the post-œsophageal ganglia of arthropods, there is a central mass formed of the myeloid substance, which is enveloped by a cortical layer of mostly unipolar ganglion-cells. The fibers from the ganglion-cells pass into and emerge again from the myeloid substance, which is a tangled mass of minute fibrillæ. The fibers from certain of the ganglion-cells we have clearly seen to pass through or over the myeloid substance and to form both the transverse commissures of the brain and also the two main longitudinal commissures connecting the chain of ganglia. But the fibers from the majority of the ganglion-cells appear, as Leydig holds, to break up into the tangled mass of extremely fine fibers, which when cut

through presents a dotted or granulated appearance. This myeloid substance remains unstained, while the ganglion-cells readily stain by reagents.

In the brain and other ganglia of vertebrates, on the other hand, the ganglion cells are internal, the fibers arising from uni, bi or multipolar ganglion-cells passing outside. In invertebrates, at least arthropods, there is no "white" or "gray" substance; none such has been described by Leydig or the later students of the central nervous system of arthropods.

Histogenesis.—If we look at the genesis of the ganglia of arthropods, we see that they consist at first wholly of spherical cells; the fibers and myeloid substance being secondary products, and their position is not homologous with that of the ganglia in vertebrate embryos. The reader is referred to Fig. 246 in Balfour's Comparative Embryology, Vol. II, p. 343. The section of the spinal cord of a seven days' chick there figured, shows that the cord is early differentiated into the internal gray mass, consisting of round cells, enveloping the spinal canal, while the cortical white substance or column surrounds the mass of ganglion-cells. In the annelidan worms and the arthropods, the embryonic ganglion is a much simpler structure, consisting of a mere mass or ball of ganglion-cells, with incipient fibers passing from them. Certain of these fibers grow longer, forming the commissures, transverse and longitudinal, connecting the ganglia. At first, then, the nervous system of the higher worms (those with a ganglionated chain) and arthropods, consists of a series of disconnected ganglia, which eventually become connected by secondary products, the commissural fibers. The fact that in worms the brain is at first separate from the rest of the ganglia, as stated in Balfour's Embryology (I, p. 291), is not of particular significance since all the ganglia, at least in Crustacea and insects, are at first disconnected from each other.

Embryology appears to give no countenance to the view held by some authors that the brain of an arthropod may represent the nervous system of the vertebrate, and the post-œsophageal chain of ganglia the sympathetic system of the vertebrates.

There seems to be a unity of plan, so to speak, in the development of the nervous system of the arthropods, and how radically different that is from the mode of genesis of the vertebrate nervous system may be seen by reference to Balfour's work (II,

250–252) or that of other observers. While the nervous system of all animals arises from the ectoderm (epiblast), as Balfour states: "In all Chordata an axial strip of the dorsal epiblast, extending from the lip of the blastopore to the anterior extremity of the head, and known as the medullary plate, becomes isolated from the remainder of the layer to give rise to the central nervous axis;" in tunicates as well as vertebrates this plate is converted into a tube or canal, which lies wholly above the alimentary tract. It is this striking feature in embryo tunicates which mainly seems to justify their elimination from the worms and

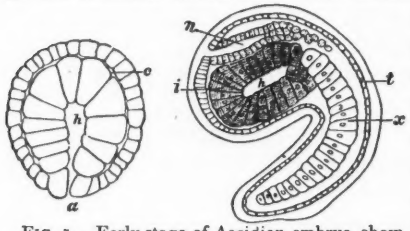

FIG. 1.—Early stage of Ascidian embryo, showing the nervous tube *n*, open in front and situated dorsally above the alimentary tube (*h*), as in vertebrates.

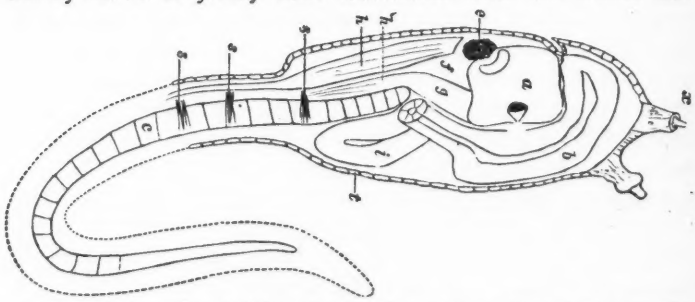

FIG. 2.—Embryo of an Ascidian, showing the vertebrate plan of structure; the nervous system *h'*, *h* with the spinal nerves (*s*) being situated dorsally above the notocord (*c*) and alimentary canal (*b*, *i*).

indicates their proximity to the vertebrates, as this seems to be a more truly vertebrate feature than even the possession of a notocord.

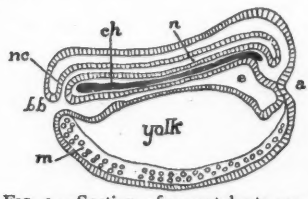

FIG. 3.—Section of a vertebrate embryo (a fish). *n*, nervous tube, open in front and situated dorsally; *ch*, notocord; *bb*, mouth; *e*, alimentary canal; *a*, place of vent; *m*, mesoderm.

Balfour states on p. 342: "The spinal cord, shortly after the closure of the medullary canal, has, in all the true Vertebrata, the form of an oval tube; the walls of which are of a fairly uniform thickness, and are composed of several rows of elongated cells. This cord, as development proceeds, usually becomes vertically

prolonged in transverse section, and the central canal which it contains also becomes vertically elongated." Then follows the differentiation (1) of the epithelium of the central canal, (2) of the gray matter of the cord, and (3) of the internal coating of white matter. "The white matter is apparently the result of a differentiation of the outermost parts of the superficial cells of the cord into longitudinal nerve-fibers, which remain for a long period without a medullary sheath. * * * The gray matter and the central epithelium are formed by a differentiation of the main mass of the spinal cord."

There thus appears to be a lack of homology in the histological topography and origin of the nervous system in Chordata as compared with the annelidan worms and the arthropods.

The relation of the nervous system of arthropods is constant; after the stomodæum has been formed, commissures from the brain pass down and connect the latter with the subœsophageal ganglion, which is ventral. This relation of the postœsophageal nervous system to the ventral side of the body is as constant as the disposition of the ventral surface of the embryo of insects before the revolution of the embryo, or of the embryos of annelid worms and Crustacea. The position of the arthropod embryo is the reverse of that of vertebrates. The vertebrate disposition of the primitive nervous system is also seen in the embryo tunicate (Figs. 1, 2).

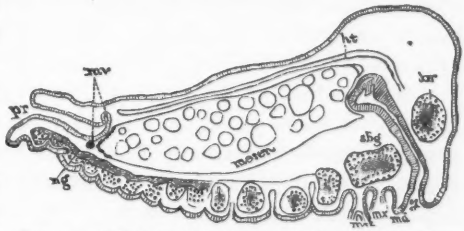

FIG. 4.—Relations of the nervous system of an embryo Orthopterous insect to the body-walls. *br*, brain: *sbg*, subœsophageal ganglion; *ng*, nervous cord; *st*, stomodæum; *pr*, proctodæum; *mv*, malphigian tubes; *mesen*, mid-intestine; *ht*, heart; *md*, mandibles; *mx*, *mx'*, 1st and 2d maxillæ. From Ayers, with changes.

Morphology.—The brain of the Arthropoda is contained in a structure which throughout is lacking in homology with that of vertebrates. The crust, the segments, and the appendages especially, have nothing in common with vertebrates, though the functions are, in a degree, the same. The origin and homologies of the sensory organs are, *ab initio*, different. For example, the eyes of arthropods are not truly homologous with those of vertebrates; the cornea is simply a number of epithelial cells, while in verte-

brates the eye externally is an ingrowth of the epiblast. As the wings and legs of insects and organs of hearing and of smell are not the homologues of the parts which function as such in vertebrates, so we are not inclined to regard the heart and nervous system of arthropods as truly homologous with the corresponding organs of vertebrates. If there is such a fundamental difference in the two types as regards the relations of the viscera to the body-walls, and if this relation is common to all arthropods and the Annulata, we shall have to go back to the hypothetical common ancestors of the tunicates and vertebrates on the one hand and of the Annulata and Arthropoda on the other, for the means of comparison. It is not impossible that in animals allied to the planarian or nemertean worms, whose nervous system consists of a pair of dorsal ganglia, with two or more pairs of nerves passing backward, that the common origin of the prochordate nervous system, and that peculiar to annelids and arthropods, may yet be discovered.

So also the resemblance of the brain, dorsally situated, of the cephalopods, enclosed as it is in an imperfect cartilaginous capsule, is interesting, but the relations are those of analogy or adaptation, and not of affinity. The mollusks, the annelids, the arthropods and the vertebrates appear to be highly specialized branches, and where there appear at first sight to be direct, cross-homologies, so to speak, between them, these are rather independent structures, the result of adaptation rather than of direct descent. Examples of such, we believe, are the eye, the brain and the heart of the cephalopods.

The unity of organization in the animal world is seen rather in the homology of the cellular structure, and in the common origin of all from unicellular forms; and among the Metazoa in the identity of the morula and gastrula conditions, or at least the germ-layers; and as regards the nervous system, in its origin in the epiblast, rather than in any special parts or organs of such highly elaborated and specialized types as are represented by the lobster, or butterfly, or fish.

The dispute between Cuvier and St. Hilaire and their followers was in part metaphysical. The old-time problems in transcendental anatomy, such as comparing a lobster to a vertebrate upon its back, the problems of fore-and-aft symmetry, and the question of torsion in the fore and hind limbs of mammals, have, if we are

not mistaken, lost much of their interest and value in the light of modern evolutionary problems, and savor more of scholasticism than of science.

At all events the present problem is, as embryology shows, so remote in its bearings; the common point of origin of arthropod and vertebrate, the fork in the primitive developmental path where the two branches began to diverge, is set so far back in the animal scale, and is so remote in geological time, that with our present knowledge we are inclined to regard the consideration of such problems as belonging rather to metaphysics than to pure science; although it should be granted that farther researches among the lower worms may yet result in the discovery of facts bearing upon the origin of the singular differences in the disposition of the arthropod and vertebrate nervous systems.

In conclusion, therefore, we are led to endorse the following opinion of Gegenbaur, in his Comparative Anatomy (English translation): "The greater size of the cephalic ganglion compared with that of the ventral ganglia, has been already seen in many of the Annulata; in the Arthropoda it is ordinarily still more distinct; this condition may be partly explained by its relations to the more highly developed organs of sense, if we recognize in the dorsal œsophageal ganglion something similar to the brain of the Vertebrata. Led by an idea of this kind, some have compared even the ventral ganglia, or ventral medulla, with the dorsal medulla of the Vertebrata, and have striven to carry the comparison still farther; these attempts ignore the complete difference between the type of structure of the Arthropoda and of the Vertebrata," p. 252.

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THE NORTHERNMOST INHABITANTS OF THE EARTH.

An Ethnographic Sketch.[1]

BY EMIL BESSELS.

THE Greenland coast bordering the entrance of Smith sound is peopled by Eskimos who are the northernmost inhabitants

[1] The present ethnographic sketch forms chapter XIX of "Die Amerikanische Nordpol-Expedition," by Emil Bessels (Leipzig, Wilhelm Engelmann). It was kindly translated by the author for the NATURALIST, as of special interest at present on account of the station at Lady Franklin bay. The original is more fully illustrated.—EDS.

of our planet. Like most other tribes of Eskimos, they call themselves Inuit, or men, not being familiar with the expression Eskimo.

This name was first given, as it seems, to the Inuit of Labrador by the Nascopi Indians and by other families of the Algonkins. In the language of the Abnaki, for instance, *eski-m ∞ha^{n}* means *he raw eats it;* and according to the "Dictionnaire et grammaire de la langue des Cris," by A. Lacombe, *aśki = cru* and *mowew = il le mange; askimowew* would therefore signify *raw he eats it.* In his valuable paper "On Algonkin names for man," published in the Transactions of the American Philological Association for 1871, Mr. J. H. Trumbull informs us that the Algonkins of New England were in the habit of calling the Mohawk tribe of the Iroquois *Mohowang-suck* or *Manquân-og*, namely, cannibals or man-eaters. For moho means to eat and moowhan, according to Eliot's Bible, he eats what lives. The formation of the word Esquimantsic, which is found in most text-books on ethnology, is probably erroneous.

It is Captain John Ross to whom we owe the first intelligence of these remote people. In the narrative of his exploring cruise up Baffin bay, during the year 1818, he makes mention of them as "Arctic highlanders," a name which should hardly be admitted, since these Eskimos invariably inhabit the coast. Ross and his companions were evidently the first strangers these people had beheld. The two men-of-war they considered to be huge monsters with wings, while they thought that the sailors themselves were inhabitants of the sun and the moon, who had suddenly descended upon them. Their garments consisted of skins; they had dogs, sledges made of bone, large narwhal tusks converted into spears, and poor knives, apparently manufactured of meteoric iron.

The second contact of these savages with white men occurred during the period of the Franklin's search-expeditions.

In 1849 the *North Star*, one of the tenders of the English squadron, wintered in their vicinity in Wolstenholme sound, and the remaining vessels of the fleet now and then came in contact with these Eskimos. Kane was the first to remain among them for any length of time, as Hayes did later. Since then they were met occasionally by English whalers who, on their way to Lancaster sound, stopped at the fast ice of the coast in the vicinity of Cape York while waiting for open water.

Kane estimated their number at 150, Hayes at 100, and our own census led to a result closely comparing with the latter. We personally saw 102 individuals, but the entire tribe did not exceed this number by more than eight or ten.

For the sake of brevity we will name these "ἔσχατοι ανδρῶν" Itanese, the name being derived from Ita, their most northerly settlement at the head of Foulke fjord. It remains to be said, however, that the entire tribe is not permanently established there, a part of them scattering over several other localities.

Their extreme northern migrations approximate the 79th parallel; southward not farther than Cape York. Hedged in from the north by the huge Humboldt glacier, from the south by the long continued precipitous edges of other ice streams, which up to the present time have not received any names, it is evident that the field of their rambles must necessarily be of very circumscribed area. Eastward they cannot move because from that direction they are barred by the inland ice. In addition to this, superstition as regards evil spirits prevents their venturing far inland. Occasionally, it seems that they cross Smith sound and visit the coast of Ellesmere land. Such expeditions, however, are not frequently undertaken, because the ice is exceedingly hummocky and scarcely passable on sledges, even should the currents and the high winds in this narrow sound permit the formation of a continuous ice-covering.

Doubtless their ancestors inhabited this barren coast for many centuries before them. It is hardly possible to determine the time at which the latter settled there; any attempt to do so would lead to useless speculations. It has been believed that not only the century but very nearly the year might be determined during which the Inuit first set foot upon Greenland; but in the absence of all reliable data we must mistrust such assertions.

This much we may say, however, with certainty, that the Inuit at the time they reached Greenland were typical Eskimos, and that since that time, where the influence of the white men has not reached them, they have scarcely changed their customs and habits. So trifling indeed is the progress which this people has made in the course of centuries, that the implements of tribes which have been separated from each other for many ages, are so similar that discrimination between them is almost impossible. On the other hand we find a remarkable resemblance between the

primitive weapons of the palæolithic man of Europe and those at present used by the Inuit. Did we not know to what extent the complicated human organism is to be regarded as a product of adaptation to its surroundings, we might conclude from the similarity of the implements, that the Inuit are the nearest relatives of palæolithic man. We learn, however, from comparative anthropology how strikingly similar are the motives developed by nations even when separated by such great distances that practically they might be inhabitants of different planets. One of the most prominent English anthropologists felt himself called upon to defend this view. He even regarded such relationships as certain, but failed to furnish the requisite proofs.

Assuming as genuine the two well-known carvings in reindeer antlers, found in the Charente of France, which represent human figures, we must conclude that the physiognomy of palæolithic man was totally different from that of the Inuit. "*L'ensemble de la tête paraît intermediaire entre le type conventionel de Mephistophélès et la tête de François I.*" These are the words used with reference thereto by Mr. de Mortillet.

The physical type of the Itanese corresponds so thoroughly to that of other Eskimos that it is not necessary to give any special description. We may state, however, that we saw a number of men, brothers, whose height was almost six feet. In this instance the stature was inherited from the mother, who measured 5.6 feet, whereas the father was of medium size.

By the courtesy of different corporations, institutes and private persons, I had the privilege of examining and measuring more Eskimo skulls than any one of my predecessors. In this manner I obtained from the Academy of Natural Sciences of Philadelphia and from Dr. Hayes all the skulls collected by the latter in the vicinity of Ita.

The number of Itanese crania which admitted of accurate measurements amounted to 101. Of these 100 specimens could be used for the determination of the mean index of breadth. This amounts to 71.37. The mean index of height deduced from the measurements of 99 crania is 76.91. The maximum index of breadth was found to be 79.8; the maximum index of height, 81.8. The respective minimum indices were 63.4 and 78.0.

The complete record of these measurements may be found in Vol. x of the "Archiv für Anthropologie." The subjoined table

contains a series of mean indices of breadth and height of various other Eskimos:

Locality.	*Index of Breadth*	*Index of Height.*	*Number of skulls meas'ed.*	*Authority*
Unknown	70.4	73 7	24	Welker.
Danish settlements in West Greenland	72.6	73.7	21	Bessels.
West Greenland	71	75	10	Davis.
Northeast America	72	75	6	Davis.
West Greenland	71.8	70.5	5	Virchow.
East Greenland	72.9	74.2	4	Pausch.
Northwest America	72	75	4	Davis.

Samuel Kleinschmitt, among the authorities on Eskimo languages, distinguishes two main dialects in Western Greenland, the northern and the southern. "The former is harsher but at the same time clearer in enunciation, more particularly of the vowels. The latter is softer but at the same time more indistinct." According to this statement the dialect of the Itanese resembles more closely the southern. The vocalization is remarkably clear, the accent singing and gently waving, while the consonants, especially at the end of a word, are most obliterated.

As regards costume, that of the Itanese approaches in character the vestments worn by the inhabitants of Danish Greenland. Both sexes wear, during winter, underclothing made of bird-skins, the feathered side next the skin. A jacket (jumper) with hood attached, and the short breeches are made of the skins of the seal, reindeer, bear or dog, the pelt of the fox rarely being used. Double or triple fur stockings are covered by waterproof boots manufactured from tanned sealskin, but once in a while the outside covering of the foot is composed of bear-skin. The men fasten their boots a little below the knee by means of a draw-string just above the lower end of the breeches, while the women wear higher boots which almost reach to their hips. This constitutes the main difference between the male and female costume. The hood attached to the jacket of the man is rounded at its apex, but that of the woman is pointed. Married women wear this hood of considerable size, because their children are carried therein until two or three years of age. Gloves are made of tanned seal-skin or furs; mittens are the most usual form worn. During the summer the heavy jackets of bear-skin are exchanged for those made of seal-skin, and the underclothing is either left off entirely or worn without any exterior garment.

Their dwellings are arched huts of either snow or stone, or they are leather tents. During the cold season, as a rule, the structures of snow are inhabited, though occasionally those of stone; tents, however, are resorted to exclusively during the summer.

The invention of the dome, which was probably made independently in three different zones of our planet, may be considered of even greater credit to the Eskimo than the invention of the sledge. The Itanese are experts in the architecture of these semispherical or hive-shaped snow-huts. Their size depends on the number of inhabitants. About twelve feet may be regarded as the average diameter of the floor, the height being approximately one-half of this. Two feet to two and a-half is the length of the blocks of snow used in their construction; their height is from ten to twelve inches; their thickness from eight to ten inches. Longitudinally the section presents three different forms. Prominent amongst these is a trapezia with two sides slightly diverging; next an elongated oblong, and finally a trapez. The greatest angle of this last rarely exceeds 109°, and the smallest is not less than 70°.

To prepare these blocks a sword-shaped snow-knife is used, made either of wood, of the lower jaw of the narwhal, or of a walrus tusk.

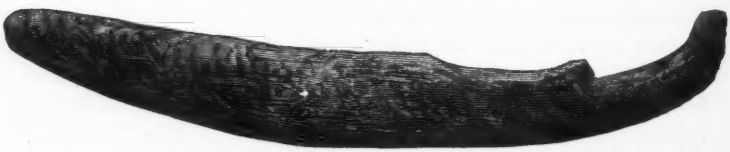


FIG. 1.—Snow knife, one-fifth nat. size, made of the wood of Dr. Kane's brig *Advance*, collected by Dr. I. I. Hayes.

Usually two persons are employed in the construction of a snow hut. While one is cutting the blocks the other joins them together. The row forming the foundation consists of rectangular pieces standing upright and forming a circle. The higher layers, however, form a spiral which is particularly pronounced on the apex of the dome. Each successive convolution has a greater angle of inclination than the preceding one. Lastly the door is cut out in the form of a gothic arch. In front of this is a short arched gang-way. Occasionally several of these huts are connected.

The interior arrangement of these dwellings is exceedingly simple. Opposite the door we find a low platform made of snow and covered with furs, which is used as a sleeping place. In case the hut is made of stone this platform is composed of the same material. Most important among the household utensils is the flat stone lamp which furnishes both light and heat. According to the size of the dwelling, one or two of these lamps are used. They are placed upon blocks of either snow or stone immediately by the side of the platform. Above the lamp is suspended, with cords of raw hide, an oblong stone cooking pot. Small racks, made of bone, serve for drying garments.

FIG. 2.—Stone lamp made of steatite.

FIG. 3.—Cooking pot of the same material.

The wick of the lamp consists either of fibers of moss or of the dried catkins of the arctic willow; likewise are these latter used as tinder, and are ignited by the sparks produced by the friction of a piece of pyrite and quartz. We also find in use the well known fire drill, the stem of which is placed between an ivory mouth-piece and a fragment of soft wood. By means of the bow the drill is set in rapid motion, which is continued until the dry wood takes fire.

In addition to those above enumerated there are but few utensils: flat dishes made of water-proof sealskin; a few knives, similar to our chopping-knives, and exclusively used by the women; the primitive implements for sewing, and finally, several scrapers of bone, ivory or stone to soften the skins, but the main work in this respect is done with the teeth.

Although the temperature inside the dwellings rarely rises above the freezing-point, the warmth appears almost oppressive to any one entering from without. For this reason adults usually discard their clothing with the exception of the short breechlets, while children frequently are left naked.

Domestic life offers much that is attractive as long as there is no danger of famine. The people are free from care and happy, and all their emotions are mirrored in their expressive counte-

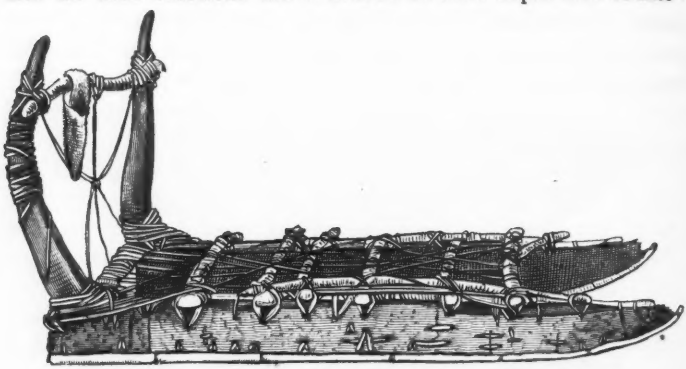


Fig. 4.

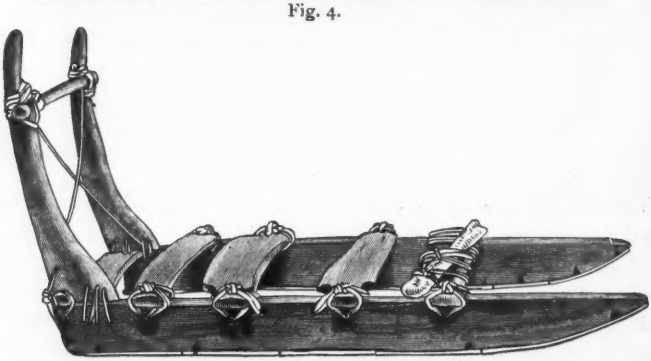


Fig. 5.

nances. Entire freedom from all restrictions and easy deportment constitute the rule.

Nowadays the sledge is the only means of conveyance used by these most northerly people. Before they came in contact with white men this was composed of pieces of bone ingeniously fastened together with thongs of raw hide, but now wood is frequently used. Fig. 4 represents one of these old sleds, copied from Ross, Fig. 5 one made of wood.

The Itanese have neither boats nor bows and arrows, although the words denoting these objects still exist in their language. This is an important circumstance, considering that they are a tribe of hunters, a circumstance indicating decided retrogression. At all other localities we find the Inuit to be brave seamen, developing great dexterity in the management of their frail skin-boats; everywhere else they are excellent archers, and handle the rifle with considerable accuracy in case the latter has replaced the more primitive weapon.

Jimmy, a southern Eskimo whom we found living with the Itanese, was the only one who possessed a bow and arrows, which he had brought from his home. They had frequently been mended, and were in a rather dilapidated condition. The bow was made of four pieces of reindeer horn lashed together with sinew, and was but slightly curved. Its length was thirty-three inches. The bow-string was four ply and made of the cervical ligament of the reindeer. It was fastened around two neatly carved bear-heads at either end of the bow. The arrows, of which he only had three, were provided with iron points. Their shafts were made of splinters of wood lashed together and feathered with raven quills. Including the point their length was from eighten to twenty inches.

The weapons used by them are the lance and the throwing-spear, which is provided with an air bladder, but is used without the throwing-board common to the other Inuit. In addition to these they have a bird-spear.

Together with the figure of a lance (Fig. 6), copied from Ross, I have illustrated another one (Fig. 7), about one-tenth natural size. The shaft of this one is composed of wood. Fig. 8 shows the upper part of the same weapon somewhat larger.

As soon as the lance has reached its aim, the shaft turns over to one side, sliding into its socket from the round base of the lance-head. This ingenious mechanism, illustrating the principle of the ball and socket joint, which could not long remain a secret to hunters, together with the fastening of the shaft-rest, is illustrated by Fig. 9. Fig. 10 represents a shaft-rest more completely finished.

Two detached spear-heads are shown by Figs. 11 and 12. The basal opening of the latter is broken and has been mended with thongs in order to prevent an accidental separation of the head

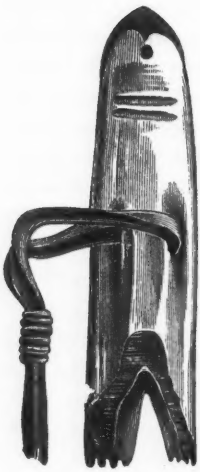


Fig. 11.

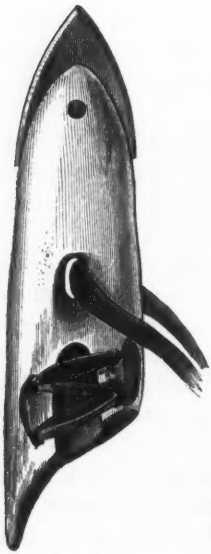


Fig. 12.

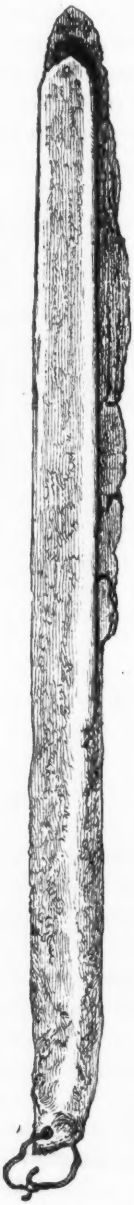


Fig. 12*a*.

Fig. 6.

Fig. 7.

Fig. 8.

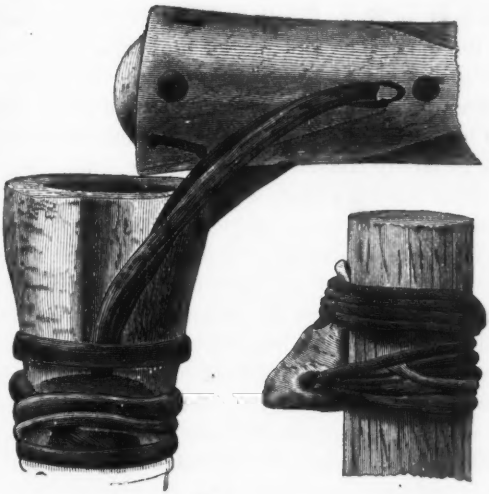


Fig. 9.

Fig. 10.

Fig. 13.

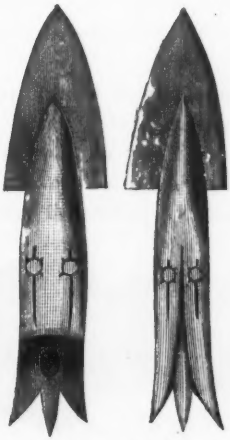


Fig. 14.

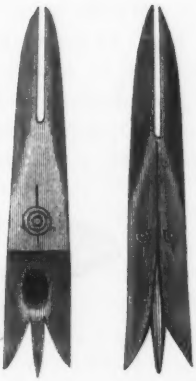


Fig. 15.

Fig. 16.

from the shaft. In both of these illustrations the long line has been severed near the loop. The first one of these figures shows immediately below the rivet two horizontal grooves, which must be regarded as rude ornamentation. They are similar to the lines observed on many palæolithic implements from the Dordogne, which were generally considered as marks of ownership.

Probably these latter are likewise rude ornaments only. They may perhaps have served to record numerically certain occurrences, as, for instance, the killing of a reindeer, a bear or some other game. It is not a matter of necessity that a primitive people should require special markings to designate their property. It stands to reason that if everyone manufactures his own weapons that these will possess a certain individuality like the handwriting of a person. The power of observation of an Eskimo who accompanied me on a sledge journey was so very acute that he was enabled to distinguish among eleven sledge tracks we came across whose sledge had made each one of the impressions in the hard snow. And this man was by no means more intelligent than his tribal relations. Whoever can discriminate to such an extent will certainly be able to recognize his own weapons without difficulty among others.

Fig. 12*a*, represents a knife, copied from Capt. Ross' narrative. Figs. 13, 14, 15 and 16 are inserted solely for the purpose of showing ornamentations as used by western Eskimos. The illustration of a stone spear-head, taken from an old grave in North Greenland, is here reproduced of two-thirds natural size.

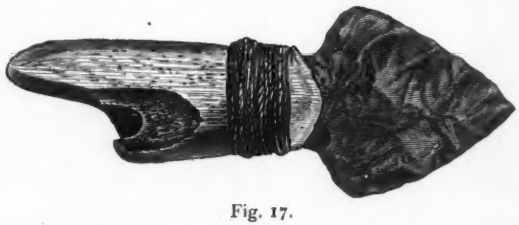


Fig. 17.

With such primitive lances, supported only by their dogs, the Itanese will dauntlessly attack the polar bear, who frequently turns out to be a most disagreeable adversary. Several of the old hunters of the tribe bore on their bodies traces of terrible laceration. They will fearlessly cope with the walrus, will become victors over the huge bearded seal, and will patiently watch

for hours and even days, in spite of cold and drifting snows, at the breathing-holes of the lesser seals.

Whatever is captured by one belongs to the entire community, the skin only is the exclusive property of the successful hunter. With the blubber and meat his own family together with those living in the same hut are first supplied; after that the others receive their shares. As long as the provisions last every table is set.

During the winter the Itanese live exclusively on the meat of the various marine mammals and of bears and foxes, while in summer various species of aquatic birds and their eggs form an important portion of their diet. Fish are obtained only accidentally, the use of the fish-hook being unknown to them. The meat is eaten either raw or boiled, always, however, without the addition of salt. A hunter returning to his home, hungry and weary from his labors, will eat eight or ten pounds of meat without the slightest inconvenience. And indeed he does not regard it as an excessive quantity. With the left hand he grasps a large chunk, stuffs as much into his mouth as possible, and cuts off this huge mouthful immediately in front of the lips. Then he masticates simultaneously on both sides, noisily smacking his lips.

Contrary to the western Eskimo, who frequently have several wives, we find that the Itanese are monogamous. Somewhat communistic tendencies however seriously interfere with the sanctity of marriage.

The average number of children in a family is two. In some emergencies the infants are frequently killed. In some instances the mother will expose her offspring at some isolated place to cold and starvation; in others she will produce death by strangulation. Little regard seems to be had for the sex of the infants.

When one of our native friends died, his wife strangled the youngest of her three children, a boy several months old, and buried him with his father. Two of the *Polaris* crew endeavored to save the little creature. They succeeded in lengthening his life by several hours, but during a short time, while they were not watching the mother, the latter accomplished the deed.

In general the children are treated tenderly; sometimes even with exaggerated affection. Thus we saw a mother who not only carried her boy, six or seven years of age, in her hood on her back, but now and then she even nursed him. Corporal punish-

ment is almost unknown among the Itanese. The little ones grow up like lap-dogs. Once I undertook to give the half-grown boy of one of the hunters a well deserved chastisement, to the great disgust and anger of my good-natured friend, his father.

The only method of punishment that I ever observed was exceedingly original. The squalling babes, scarcely able to walk and totally divested of clothing, were placed on the snow by their

FIG. 18.—Kalutana, the patriarch.

mothers until they stopped crying. And this happened several times when the temperature was more than twenty degrees below zero.

It is a very easy matter to satisfy the demands of the children regarding their amusement. Usually the boys play with small sleds, and after they are a little older practice spear throwing. The girls have dolls carved from ivory or bone and clad with furs, or they have small figures representing animals. Favorite play-

things are young pups, who are tortured with entire disregard to their feelings.

Several of the western Eskimo tribes are in the habit of tattooing their young girls; this, however, is not done by the Itanese. Jimmy's wife, who came from the west, showed a simple pattern of tattooing on her face, and was for that reason often

FIG. 19.—Mother and child.

ridiculed by the other women. At one time I painted the face of a girl about ten years of age with water-colors, which caused her to cry bitterly when she saw herself in a looking-glass. The mother of the child, supposing the color to be permanently fixed, threatened to assault me, and was not satisfied until I washed off the marks.

As soon as the boy has reached his twelfth or fourteenth year he is allowed to accompany the hunters when catching seals, and learns to drive the sledge dogs. After the period of puberty the girls, in their fifteenth or sixteenth year, have already become sufficiently expert to assist their mothers in the preparation of clothing. This together with the propagation of their race are the two main occupations of these northerly women. Their cooking requires but little knowledge, neither do their other domestic duties, except the dressing of the game.

At the time the young man is able to provide for the necessaries of life, he takes unto himself a wife. Generally the marriage is one of love, rarely of convenience. In case the marriage is not ordered by the parents, then the consent of the girl's parents is all that is required. The widely spread ancient custom to apparently abduct the girl of his choice, although she may be perfectly willing, is the rule.

Among the Inuit the communistic mode of life is so pronounced that the dower scarcely comes into consideration. A sledge, a team of dogs and the rude weapons are essentially the total personal property of the man, while the woman owns a lamp, a cooking-pot, a knife and a few needles. In addition to this we may mention the scanty wardrobe.

Under such circumstances the individual physical advantages enter largely into the motive of selection. Added to these are those qualifications which may enable the individual to contend for his existence. Our knowledge at present is not sufficiently advanced to fully enable us to characterize the ideal of physical beauty as conceived by savage tribes. The differentiation of this ideal, however, will necessarily stand in most intimate relation with the division of labor between the sexes. Wherever such division is but slight, there we will find the expression of countenance but slightly differing in man and woman.

As a rule the Eskimo seems to prefer full forms. In how far individual taste may herein be consulted remains to be established. The woman expects the man to be a good hunter, and his endeavor is to obtain a companion possessed of the requisite aptitude to perform her domestic duties.

Although marriage is very easily entered into, it can only be annulled with certain ceremonies. Several of our crew had occasion to witness a divorce:

Manek, one of the young girls of Ita, had been forced by her father to marry Inuk the hunter. But her heart was another's. To him she conceded, after her marriage, the privileges that should have been her husband's, and perhaps those of other married hunters of the tribe. Inuk, driven by jealousy, pursued her with a knife and slightly wounded her side. This determined her father no longer to oppose her affections. In the future Manek was to be the wife of the man she loved. She was divorced from her husband who had been unable to gain her affection. While Inuk was stretched in his hut lamenting his fate and stubbornly refusing meat and drink, Manek underwent the ceremony proper in the hut of a neighbor. With her knees drawn up to her chin she was lying on her back on the bench. Around her head was fastened a leather thong, the end of which one of the oldest women of the tribe held in her hands, murmuring unintelligible words in sing-song tone. She kept steadily pulling at the thong so that Manek's head rose and fell at intervals for more than two hours. Of Manek's relations her brother-in-law was the only witness. After the completion of the ceremony he put the woman on his sledge and took her to a neighboring settlement. Waiting for her she found her lover, who clasped her in his arms and led her to his hut. A few days later Inuk paid us a visit. He was completely reconciled to his loss. When we inquired about his former wife we received the unexpected answer that Manek was a very wicked person.

Shortly after this divorce a burial took place. The corpse was wrapped in furs, placed on a sledge and buried in the snow with its face turned westward. After it had been covered the sledge was placed across the mound and the weapons of the deceased laid beside it. This done the men put plugs of hay in their right nostrils, the women in their left. These plugs were worn for several days and only taken out when entering one of the huts.

Not always, however, are their dead treated in so careless a manner as in this instance. It is true that a regular grave is never made in the frozen soil, but as a rule a hollow mound of stones is erected over the body should frost and deep snow not prevent this.

It is not an easy matter briefly to treat of the religious views of the Itanese, who believe in the immortality of the soul. Other questions also we must refrain from discussing in order not to ex-

ceed the limits of these pages. Whoever desires to become familiar with the legendary treasures of the Eskimo will find ample material for enjoyment in Rink's "Tales and traditions of the Eskimo." The traditions given by him readily prove that the mental power of this primitive people is by no means of an inferior order. Vivid as their imagination is, they endow with genius and life the rigid rock and the soughing wind, the twinkling stars and the flashing aurora, in short, the various astral and telluric phenomena.

Inasmuch as this psychological process involves one of the leading principles of beauty, it may not be without interest briefly to examine in what manner the conception of beauty manifests itself among the Eskimo.

The discussion of this question is rendered the more important if we remember the remarkable similarity between the weapons and utensils of the reindeer period of Europe and those of the Eskimos. Still more importance must be granted considering the fact that the extinct race of Europe existed under analogous circumstances. And we may regard it as an indisputable fact that like causes produce like effects.

At the present time the question whether the engravings and carvings of the Palæolithic period found in Southern France and Switzerland are genuine, has become one of great moment. Since it has been found that some of the Thayingen specimens are counterfeits, the tendency has prevailed to deny the conception of beauty to all so-called primitive people. More particularly does this apply to their ability to depicture animal forms. To the advocates of this view it seems difficult to conceive how a people able only to manufacture rude stone implements could possess the requisite talent to engrave upon horn and bone the figures of animals bearing a certain artistic character both in outline and disposition.

A view like this may partly be justified since, in prehistoric times, the ability to make pictorial representations appeared suddenly and just as suddenly was lost. It remains to be said, however, that up to the present day but a very small number of specimens of this kind have been found, indeed we have just begun to unearth them. The deterioration of this so-called prehistoric art is in itself no matter of surprise, and it is not without a parallel.

That pictorial representation of natural objects has not developed uniformly in the course of time, is an established fact. Do we not find numerous paintings by old masters in which the landscape is crude and totally neglected, while upon the human figures all possible care and attention has been bestowed? Are

FIG. 20.—Interior of a hut.

there not great compositions in existence in which the action of the human figure portrays the innermost secrets of the soul, while the animals associated with them, were it not for their color, would certainly even puzzle a zoölogist?

Whoever considers these circumstances will probably come to the conclusion that the gap between a stone knife and an ornamented piece of bone is not as unsurmountable as it seems.

We need not be surprised to find that the sense of beauty is less developed among the Itanese than among more highly favored southern Eskimo tribes. Wherever the existence of man is hampered by a severe struggle for his physical welfare; wherever the energy of the individual as well as that of the community must solely be directed towards the satisfaction of bodily wants there remains but little time to enjoy beauty of form or to create such.

In spite of all this we find varying ornamentation of the clothing and utilization of differently colored skins and furs which might even satisfy a taste educated in art.

During the winter several of the hunters carved in our presence animals and human figures which were exceedingly characteristic. With very slight means they succeeded in representing the typieal physiognomy of the Inuit as well as to express that of the white man. Many of their animal forms were unmistakable.

In spite of all this the talent of the Greenland Eskimo for plastic representation is less developed than that of the western tribes. More particularly among the tribes of Bering strait there are excellent carvers in ivory whose productions, in some instances however, clearly show the influence of the neighboring Indians. To investigate the degree to which one primitive people may in this respect be influenced by another would be a work of no little interest.

The National Museum of the United States contains numerous carvings of these north-western Indian tribes. Among many specimens which may be considered as barbaric, are some sufficiently good to claim our attention. Whoever has had occasion to observe the expressive countenances of the wooden statuettes No. 713 and 714, representing Indian figures, would certainly not be tempted to consider the " browsing reindeer " an extraordinary production.

An ivory torso exhumed by Dr. Hayes from an old grave in the vicinity of Ita, is the subject of the appended illustration. It is a matter of regret that the annexed wood-cut does not do full credit to the subject. The original, as seen from the left, shows a very pretty side view, the back is totally devoid of detail; in the vicinity of the hips, however, and in the lower extremities the anatomical form has been well reproduced. Fig. 21.

After I had myself made a series of experiments in carving

ivory with stone and metal, I came to the conclusion that the above-mentioned torso was not produced by means of stone implements.

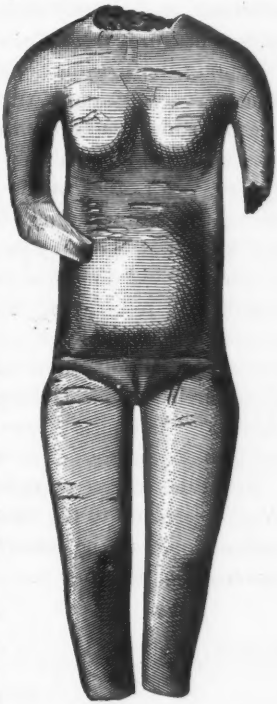


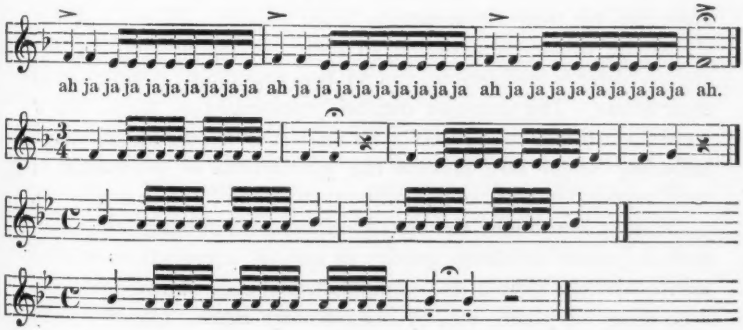
Fig. 21.

It would be reasonable to suppose that among a nation of hunters who possess any appreciation of music, at the same time using bow and arrows, we should find primitive stringed instruments. The incentive to the construction of the latter would be given by the twang of the bow-string.

None of the Eskimo tribes, however, which make use of this weapon, possess instruments of such character. The drum, made of a rude bone hoop covered with an elastic skin, was the only musical instrument found. Commonly a femur of a walrus or seal is used as a drum-stick.

But little is to be said in favor of the music of the Itanese. At irregular intervals he mercilessly pounds his instrument, moving the upper portion of his body to the right and then to the left, singing a tune which lazily proceeds with slight gradations upon a slightly varying key-note.

The following may give some idea of the character of this song:



It must be stated, however, that this reproduction is correct in part only, because many of the intervals amount to less than a semitone, and cannot therefore be expressed by the customary system of musical notation.

Among the Eskimos near Bering strait the intonation is very similar. A sergeant of the U. S. Army who was stationed near Norton sound, repeated the songs to me. Even the senseless text is the same with the exception that the *a* in *ah ja* is more like a^n: with other words it is entirely nasal. It seems that in former times the southern Greenlanders had a similar song. The well-known Eskimo Joe sang for me a series of notes the shades of which could doubtless be analyzed with the aid of a series of Hemholtz's resonators. Parry furnishes in his "Second voyage for the discovery of a Northwest passage" (p. 542), the song of the inhabitants of Winter island. Although decidedly lugubrious some of these phrases nevertheless move over two and a half intervals. The text is *Amna Aya Aya Amna ah*, similar to that of the Itanese and the other inhabitants of Greenland.

From these brief remarks it may be seen that the Inuit from West Greenland to the shores of Bering strait possess a common ancient song, a song which in the course of time has undergone less modification than even their language.

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OPINIONS UPON CLAY STONES AND CONCRETIONS

BY L. P. GRATACAP.

CLAY dogs, clay stones or clay concretions are terms indifferently applied to a singular class of objects which occur in clay beds of recent or Quaternary age, in spots where conditions favorable for their development have existed. They certainly strike the eye as remarkable in their curious mimicry of the shapes of birds and beasts, and in the capricious complexity of their forms. The question inevitably provoked by them: How were they made? has received an answer of a generic character, including under one process the phenomena of spherulites in lava, septaria in iron ores, flints in chalk, nodules in sandstone, peastone in limestones, the hexagonal columns of basalt, the structure of granite boulders, geodes of quartz, segregations of iron pyrites and the simple and complicated shapes shown upon the accompanying plates, viz., by *concretionary action*. Concretionary

action has been assumed to indicate a cohesive and attractive property in matter when finely divided, and when its particles possess some or considerable freedom of motion, whereby molecules of the same sort gather together in bunches or globes, sometimes coat over coat, the whole enlarging until the limit of cohesive action around that center has been reached, or the expanding circumference of one concretion meets and impinges upon its growing neighbors in a mass affected throughout by this "toward-a-center" movement. This is a partial confession of ignorance as to what the essential nature of the process is. We are led to believe from the analogy in all these cases enumerated above, that the action is the same, and perhaps it is, but modified by varying conditions and the constitution of the substance influenced.

It is doubted whether basaltic columns can ascribe their formation to concretionary action, and it is plainly stated that geodes arise from the entrance of saturated solutions from without, through fissures, into the cavities formed within clay or other nodules, by internal shrinkage, of which process the familiar hollow iron ore balls are a good illustration.

The authorities are not inclined to throw much light upon this curious phenomenon, regarding it as an ultimate fact in nature. Dana gives no explanation of this process (Manual, 1879, pp. 85, 86, 87, 88) but illustrates it in various figures. In the Manual, 1875, he speaks of concretions "having the form of, or containing spheroidal concretions; some varieties are also called globuliferous when the concretions are isolated globules and evenly distributed through the texture of a rock; others are oölitic when made of an aggregation of minute concretions not larger than the roe of a fish." He speaks of one example as "a crystalline rock with spherical concretions imbedded in its mass and not separable from it * * * each layer (of the three forming each concretion) consisting of different minerals, for example, garnets the center, feldspar the middle layer and mica the outer, and all making a solid mass. The constitution of such concretions is very various. In rocks containing feldspar they usually consist largely of feldspar and sometimes of feldspar alone or of feldspar with some quartz. The concretions in pitchstone and pearlstone (called spherulites) are almost purely feldspathic, and often separate easily from the rock." He figures

concretions in sandstone, and one notable one where in the areolets included between the cracks of an argillaceous sandstone, concretions have formed, bounded by the polygonal sides of the cell. Unfortunately there is no word said as to the nature of the concretion, whether entirely like the rest of the rock, nor whether the entire sandstone partakes of this nature. He also alludes to crystallized bunches of quartz and pyrite as instances of concretionary action, remarking that "this tendency in nature to concentric solidification is so strong that no foreign nucleus is needed."

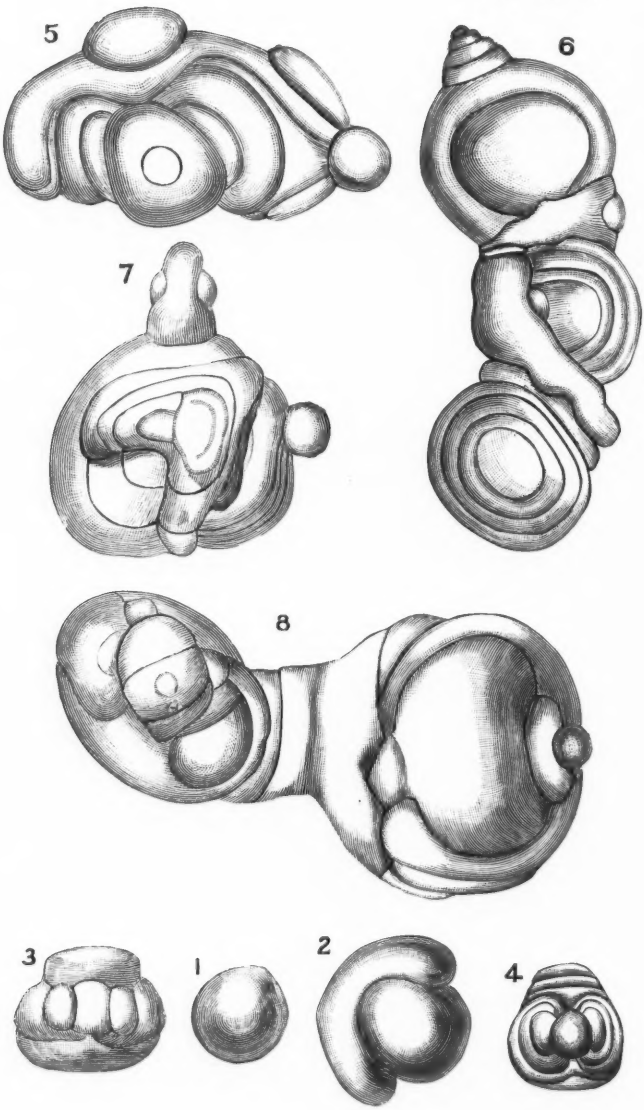
In the Text Book for 1883 he says much the same thing in abbreviated form, referring with more doubt to the concretionary character of basaltic columns, but defining the process as "the result from a tendency in matter to concrete or solidify around centers."

Le Conte, in his Manual of Geology, devotes three pages to concretions, explaining them as occurring "whenever any substance is diffused in small quantities through a mass of entirely different material. Thus if a stratum of sandstone or clay have small quantities of carbonate of lime or carbonate of iron diffused through it, the diffused particles of lime or iron will gradually, by a process little understood, segregate themselves into more or less spherical or nodular masses, in some cases almost pure, but generally inclosing a considerable quantity of the material of the strata. In this manner lime balls and iron ore balls and nodules, so common in sandstones and clays, are formed. In like manner the flint nodules of the chalk were formed by the segregation of silica, originally diffused in small quantities through the chalk sediment. Very often some foreign substance forms the nucleus about which the segregation commences."

Dr. Dawson, in a note upon cone in cone structures in his Acadian Geology, says of ordinary concretions, "they are in general attributed to the mutual attraction of particles diffused through masses of sediment and aggregating themselves around solid bodies as nuclei, or flowing into cavities of fossils and other places of least resistance."

Professor A. H. Green, in his Manual of Geology, says, speaking of laboratory concretions in chemical solutions and precipitates: "That nodules are being formed in the same way in some rocks now in the course of deposition. It is usual to speak of

PLATE XXVI.



this process as concretionary action. There is no objection to be raised to this phrase, and it or some similar term may be safely and conveniently used to express the fact that certain matters have been separated out of the body of the rock and collected together in balls, provided always we bear carefully in mind that by giving the process a name we do not get any nearer to understanding the manner in which the result has been brought about. If any one asks us what made the nodules, we may, if we like, say concretionary action; but if the awkward question is put, What is concretionary action? we should be somewhat puzzled for an answer. We know that one of the ingredients of a mixture has been extracted from the surroundings and gathered into lumps; how exactly this was done we do not know. The term, in fact, is only a way of stating our ignorance, and, unless due precaution be taken, a somewhat dangerous way, because to certain minds it looks like an explanation."

This remark of Professor Green echoes the German couplet:

> "Denn eben wo Begriffe fehlen
> Da stellt ein Wort zur rechten Zeit sich ein."

Archibald Geikie says (Text Book of Geology): "Concretionary, containing or consisting of mineral matter which has been collected either from the surrounding rock, or from without, round some center so as to form a nodule or irregularly shaped lump. This aggregation of material is of frequent occurrence among water-formed rocks where it may be often observed to have taken place round some organic center such as leaves, cones, shell-fish remains or other relics of plants or animals. Among the most frequent minerals found in concretionary forms as constituents of rocks are calcite, siderite, pyrite, marcasite and various forms of silica. In a true concretion the material at the center has been deposited first and has increased by additions from without, either during the formation of the enclosing rock or by subsequent concentration and aggregation. Where, on the other hand, cavities and fissures have been filled up by the deposition of materials on their walls and gradual growth inward, the result is known as a secretion."

M. Virlet, on the 20th January, 1845, presented to the Geological Society of France, a paper upon this subject, in which he claimed that concretionary masses had been formed subsequently to the deposition of the rocks or layers in which they were found,

by a molecular displacement, the particles of the concreting substance being gathered together by some action similar to electrical action. The paper elicited from M. Becquerel assent in the following words: "A mass of geological facts adequately show that there has been and is yet, in different rocks, centers of action around which foreign substances and their compounds gather. There is no doubt that these transferences of molecules may have been effected by forces analogous to electricity, but it is not sufficient to suppose that the phenomenon has an electrical origin, it is necessary to prove it; this is what I have already done in a certain number of cases by reproducing these compounds," &c.

M. Virlet, in the same paper, compiles a chronological statement of the views held by geologists and chemists previous to his own publication, from which the following notes are taken.

In 1816 Mr. Buckland speaking of nodular siliceous beds and the flints of chalk, says they seem to have been formed whilst the material which encases them was yet soft, and to have reached their hard or solid condition almost contemporaneously. The separation of the silica from the calcareous mass would have been achieved through the attractive forces which drew the siliceous particles towards certain centers. In 1834 M. de La Beche remarks, "that we see in the rocks of mechanical origin certain very remarkable aggregations which must have been produced by the mutual attraction of the molecules which compose them." He remarks that these nodules contain more carbonate of lime than the marls and argillaceous schists which surround them, and in allusion to their laminated character says, "that we can scarcely doubt that they have been formerly the continuation, one of the others. The molecules of calcareous matter have separated themselves from the marls to unite as we now see them, and we would not probably be mistaken greatly if we assumed that the beds of the particular deposit, without containing sufficient carbonate of lime to form successive beds, contain nevertheless too much of it to remain disseminated in the marls without being gathered into small masses."

Mr. Babbage showed that siliceous particles form concretionary-like bodies in the clay preparations used in the manufacture of porcelain. M. Virlet objects to the finding of any analogy in the two cases, as the pottery mass has been formed at once and the natural beds have been deposited slowly over long periods.

Sedgewick considered concretions very interesting, inasmuch as they indicate that the determining causes are due to some débris, either animal or plant, or some small invisible grain which he remarks is in accord with what experience has taught us in the precipitation and crystallization of salts, which ordinarily are determined by the presence of foreign bodies in the midst of a saturated solution. The same action, as seen in the formation of calculi in the bladder, he discerns in nature, and regards the presence of strange bodies as formative of concretionary centers, where the material separated from the different beds has gathered together. The principle of all this he suggests may be bound up in the assertion that like seeks like.

M. Turpin, speaking of siliceous concretions in the chalk, says if we admit that the nodules of flint owe their transformation to the decomposition of innumerable plants or animals, which live either in salt or fresh water, and upon these marine or lacustrine floors the débris or the entire bodies of these beings fall and pile themselves up upon each other, so as to form great beds, more or less thick, made up of everything, if we recall that these animals are made up in great part, first, living organic matter, second, calcareous material, third, silica, these two last having been absorbed and secreted molecularly and confusedly in the interstices of the first; if, in this pasty bed, gelatinous and very liquid, that we may call *barégine*, a bed where all is mixed, we admit, as appears proven, the separation, more or less complete, of siliceous particles, and the conglomeration of the first amidst the second, as the globules of blood and those of milk, for sake of comparison, separate from the serum to form clots, we can imagine that any natural object, organic particle, &c., might form the center of their concretionary growth or be enveloped in their outward extension. M. Virlet thinks M. Turpin proves too much, and that if such an attraction were universally so, clay beds or siliceous limestones would not be homogeneous but form themselves into beds of nodules of silica and lime.

Lyell, in his Elements of Geology, thinks that the molecules were held in suspension in water; once deposited, those which have a similar nature appear to exercise mutual attraction upon each other and gather in certain spots, where they form heaps, nodules and concretions. He instances the celebrated beds of magnesian limestone in the north of England, where the size of

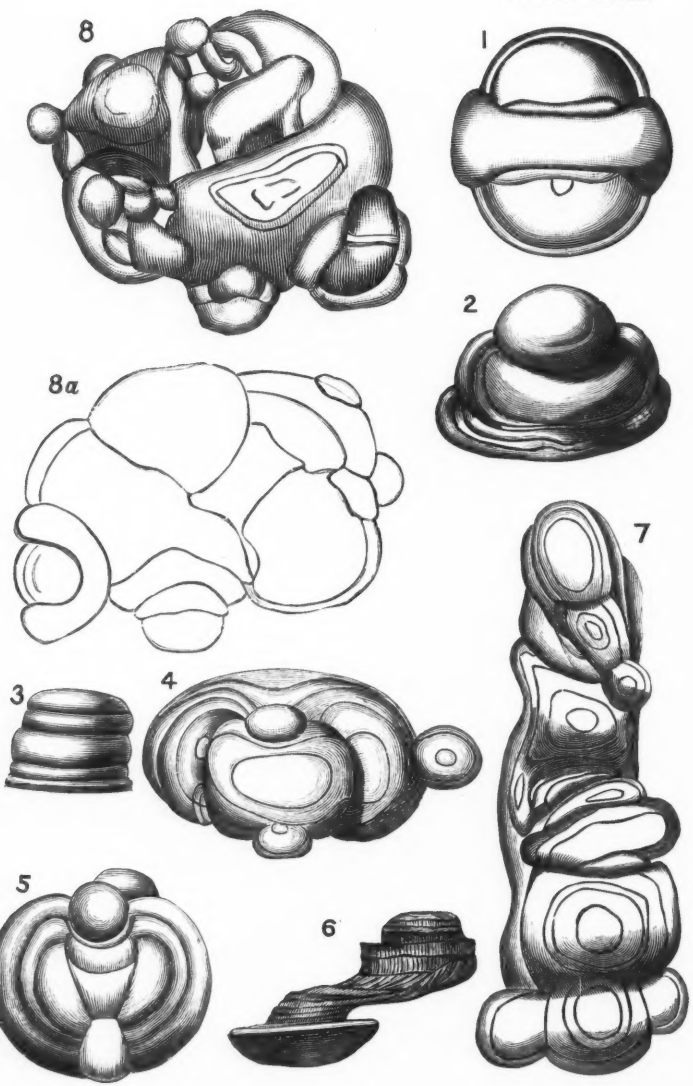
the spherical concretions greatly varies from that of a pea to those many feet in diameter, while they are intersected by the laminæ of the original deposit.

The stones of Imatra, which have attracted much attention and are like our clay dogs, have been studied by M. Parrot, who has ventured to classify the irregular shapes under the names of monotypes, ditypes, tritypes, tetratypes, pentatypes and polytypes. Hypotheses to explain these have been various; first comes the gyration theory, which is inadmissible; the stalactitic theory explains them by infiltration, the vegetable theory regards them as fossil toadstools, another theory considers them as coprolites, the animal theory, which M. Parrot defends, considers them as the remains of petrified animals similar to Medusæ.

Bowerbank and Parkinson attributed many flints to a coralloid origin as being alcyonaria which had attracted silex and had been covered with a gray crust presenting no trace of organization, and that they had then been penetrated by chalcedonic flint, red or purple, which had replaced the molecules of the animal matter as it decomposed.

In Vol. IV, 2d series, Transactions Geological Society of London, Dr. Fitton, in his paper upon the strata below the chalk, says, "all stages of gradation can be perceived from distinctly separated concretions of stone to others so nearly uninterrupted that the next step into perfect continuity can be easily conceived;" again he writes, "in all these cases the concretions must have been formed after the deposition of the sand which includes them, and probably beneath a great depth of compacted materials. In such a mass, shut off from the free access of air and change of temperature, there is no obvious reason for disturbance of affinities which maintained the original form of the components, except the decomposition of the animal and vegetable remains diffused among the stony substances, yet here we have not only solid limestone, where nothing but loose sand and gravel were before, but firm siliceous concretions pervading, and so identified with the separated particles of the quartzose sand that the whole is nearly homogeneous. If the decomposition of the organized substances, continually acting throughout very long periods of time be not sufficient to produce the whole of these effects, perhaps it may be supposed that electricity is the cause which sets free the elements and disposes them anew."

PLATE XXVII.



In the special instances of concretions known as clay stones—carbonate of lime, clay, sand and iron—two writers have treated of them at considerable length. Parrot, in the Memoirs of the Academy Sciences St. Petersburg, Vol. v, 6th series, gives a very extended examination of the stones of Imatra, which ends very inconclusively with assigning them to an organic origin. His figures are very interesting, and differ considerably from the familiar forms of the Connecticut valley.

Professor Hitchcock, in the Geology of Massachusetts, devotes considerable time to them, and his remarks are most important. He considers them as formed by the crystallization of calcite in clay, that lateral accretion predominates, from the easier movement in the clay particles sideways, that different localities have different forms, and that they are laminated by growth from segregation in successive layers of the clay bed. He seldom finds nuclei.

The writer's examination of a collection of these objects seems to warrant the following conclusions:

1st. That in their formation they have passed through a preliminary or soft stage, before hardening, more or less long (Pl. XXVI, Fig. 7; Pl. XXVII, Fig. 1).

2d. That the process of a concretion has formed a center about which others gathered; has, as it were, precipitated and induced more extended action of the same sort (Pl. XXVI, Fig. 5).

3d. That the approach to solidity of a concreting mass is attended with a development of new centers around which concretions form (Pl. XXVII, Figs. 7-8).

4th. That the tendency of matter is to concrete around a center from all sides equally, but that if there is deficiency of material, on the side where the material is plentiful, the form will correspond (Pl. XXVI, Figs. 2, 5, 6).

5th. That concretions lie parallel to the bedding, are flattened vertically, are wider than high (Pls. XXVI, XXVII).

6th. That the upper surfaces are varied and in relief, while the bottoms are apt to be flat (Pl. XXVII, Fig. 8).

7th. That the concretion is often plainly built upwards by the superimposition of many films (Pl. XXVII, Figs. 2, 3, 6).

8th. That the amount of carbonate of lime varies: according to Hitchcock, 43 per cent to 56 per cent; Parrot 51 per cent to 55 per cent; Swedish, 60 per cent to 61 per cent; the writer, 45.63 per cent.

9th. That the concretions vary in specific gravity: Parrot, 2.5, 2.49, 2.54, 3.34; the writer, 2.60, 2.57, 2.67, 2.59.

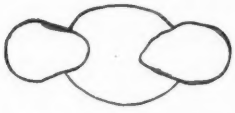
10th. That many show periods of growth (Pl. XXVI, Figs. 4, 6; Pl. XXVII, Fig. 5).

Further, the results of microscopic examination have been these: A horizontal, equatorial section of an oblate concretion, when examined with an one-eighth objective, showed an area densely crowded with crystalline points of calcite, so closely packed as to resemble a patchwork of fine mosaic, of which the separate pieces varied in *apparent* size from $\frac{1}{4}$ to $\frac{1}{2}$mm. This was seen in polarized light. No apparent variation in their number between the center and circumference of the disk was noted, but there were evident crowds or congeries of these shining specks in places, though usually their distribution was uniform.

Between crossed Nichols irregular and loosely connected dark blotches or clouds appeared over the field between which, in the lacunæ, shone transparent plates of calcite varying in size. Black lines in labyrinthine reticulations seemed to outline the calcite crystals, the latter lying in their meshes.

A cross vertical section revealed no linear arrangement of calcite crystals, and in the slide in question the minute tesselation of the horizontal section was repeated upon a possibly denser and more microscopic scale, whilst between crossed Nichols the spots, loops and blotches of clay became very noticeable.

A horizontal section through a group of three concretions showed the subjoined outlines, when a plane surface was ground for its attachment to the glass, the outlines of the two side concretions being very faint.



The section presented, under the microscope, no differing features from those examined before, unless the groupings of calcite specks were slightly more marked. The clay lines seemed larger and more meshy, like a net. On removing the calcite with hydrochloric acid the clay remaining on the slide presented a surface of perforations. The apertures varied in size, indicating the comparative size of the calcite crystals removed by the acid, though many such openings were previously filled up with packed calcite lenses. Sometimes the holes left by the removed calcite were inclined tubes, and the fenestration was like a bryozoan surface. The acid washed on the thin film though quite

strong, did not entirely remove the calcite, it lingered still, entrapped in the clay particles.

The assumption which may combine these features and accords with microscopic examination seems to be this: That in the clay beds where these dogs occur there were variously shaped spots or irregular separations between layers where moisture remained for a long time, keeping the clay in a plastic, more or less liquid form, and that with the withdrawal of water to these points, the soluble carbonate of lime was also gathered there. This latter became concentrated by the contraction of the magma, or through introduction of more carbonate of lime in solution in percolating waters.

Upon concentration the carbonate of lime crystallizes within the mass and one crystal speck thus appearing would form a center of growth around which the new crystals would gather, drawing in clay with them. If this action occurred in a narrow seam-like plane the concretions would be flat, if in a wider area more spherical Sphericity of growth seems an ultimate principle, but contraction of space and thinness of the concreting layer for the most part causes the concretions to expand symmetrically all around.

Where spots of this character coincide one over the other in rising layers of the clay beds, a pillar is formed, where they connect obliquely a slanting pile of disks is made (Pl. XXVII, Fig. 6). As the material in one of these areas becomes consolidated, we may suppose the upper surface to become denser and crystallization beginning at a number of points the surface is broken up in a number of separate forms. Thus the small wart-like bodies would seem to have formed quickly and to have become fixed at once.

This growth may have been quite gradual or quite rapid, but in all cases due to the concentration of the calcite solution in the clay magma and then its crystallization. It could have been interrupted, irregular, more on one side than another, two or three or more concretions may have originated at the same time and grown towards each other, or interfered and enveloped each other in endless diversity of ways. One concretion may have become the center around which others grew, or a small concretion may have formed in the midst of a larger one, the quantity and state of the carbonate of lime varying from point to point. A certain

freedom or play of the particles, *i. e.*, a certain plasticity, seemed necessary to secure symmetrical forms, beyond which the magma simply hardened without form, as in the amorphous bands connecting concretions or overlapping them (Pl. XXVI, Figs. 8 and 6), or underlying them.

The peculiarity noticed in many of the concretions of their apparent growth upward by films or from a side, is analogous to the habit of crystallizing fluids which begin to form crystals along the line of attachment, and this in some cases seem dependent on the lamination of the clay beds.

It is singular, and I find Professor Hitchcock makes the same observation, that in the Fontainebleau limestone, with as much or less carbonate of lime in their composition, the calcite has carried the sand into its rhombohedral forms, which it has failed to do with the clay in the clay stones. It would seem that in the former case the carbonate of lime crystallized rapidly and *en masse*, as it were, in the sand, whereas in the latter the calcite formed more or less slowly, and was disseminated in minute points through a *plastic* mass of clay.

NOTE.—In Pl. XXVII, fig. 8*a* is the under view of fig. 8—a flat surface.

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THE CONDYLARTHRA.

BY E. D. COPE.

(Continued from page 805, August number.)[1]

PHENACODONTIDÆ.

THE genera of this family display a uniformity in the structure of the true molar teeth not seen in the Periptychidæ. Their range of grade is seen in the premolars, especially those of the superior series. Thus in Protogonia, all of those teeth have but a single external lobe. In Phenacodus the fourth has two external lobes. In Diacodexis the second, third and fourth teeth have two external lobes. The premolars are unknown in Anacodon. While Protogonia is primitive in its superior premolars,

[1] It is necessary to notice two errata which occur in the part of this paper already published in the last number of the NATURALIST. In the diagnosis of the suborder Hyracoidea, page 792, line 10, fibula is printed instead of tibia. The same error occurs on page 793, line 13. Second, the figures of *Ectoconus ditrigonus* are natural size, and not two-thirds of it, as stated.

its inferior true molars come nearer to developing Vs than any other genus of the family. The definitions are as follows:

Last superior premolars with but one external cusp; inferior molars with Vs. *Protogonia.*

Last superior premolars with two external cusps; inferior molars with well-developed cusps..... *Phenacodus.*

Inferior molars with flat grinding faces; no cusps..... *Anacodon.*

Second, third and fourth superior premolars with two external cusps; those of inferior molars well developed..... *Diacodexis.*

Of these genera the only one which is restricted to the Puerco epoch is Protogonia. Some species of Phenacodus are Puerco, but the majority are Wasatch, while the two remaining genera are Wasatch.

The two species of Protogonia are known in the Puerco fauna as the only ones, with three species of Phenacodus, which possess regularly quadrituberculate superior molars. The simplicity of their fourth premolar and the absence of the external cingular cusp of the superior true molars proclaim them the most primitive species, as they are the oldest, of the family. The smaller species, *P. plicifera* Cope[1] (Fig. 14), has a skull as large as that of a terrier dog. The *P. subquadrata* is larger and otherwise different.

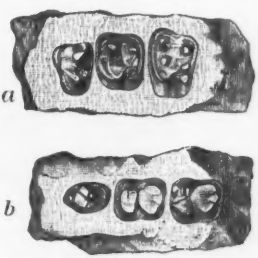


FIG. 14.—*Protogonia plicifera;* parts of superior and inferior dentition, nat size. From the Puerco beds of New Mexico. Original, from Report U. S. Geol. Survey Terrs., Vol. III.

In the genus Phenacodus Cope, we have the best known representative of the order Condylarthra, and the one to which the largest number of species is referred. Almost perfect specimens of the *P. primævus* (the type) and the *P. vortmani*, were found in the Wasatch Eocene sandstone of the Big Horn river of Wyoming (see Plates XXIX and XXX).

The dentition includes the normal number found in the least modified Mammalia, viz., I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$; and the series is not interrupted by important spaces. The canines are weak, and none of the premolars in either jaw resemble the true molars. The latter are quadritubercular, with intermediate tubercles both above and below. The last inferior molar has a fifth lobe.

[1] The best specimens of this species are not yet figured.

The skull (Fig. 15) is distinguished by the posterior prolongation of the nasal bones, which extend to between the orbits in *P. primævus* (Plate XXVIII), constituting a slightly nearer approach to the living genus Tapirus than exists in any other extinct genus now known, the premaxillaries are slender, and do not unite in front. Posteriorly they reach to the nasals, but not to the frontals. There are no postorbital processes either of the frontal or malar bones. Sagittal crest present. The palate is excavated beyond the posterior border of the last superior molar, and the pyramidal processes of the palatine bone are not separated from the maxillaries by a notch. Postglenoid processes prominent, no trace of preglenoid ridge. Posttympanic process short, widely separated from the postglenoid in front by the meatus auditorius, and from the paroccipital behind by the robust bases of both processes. Petrous bones probably small.

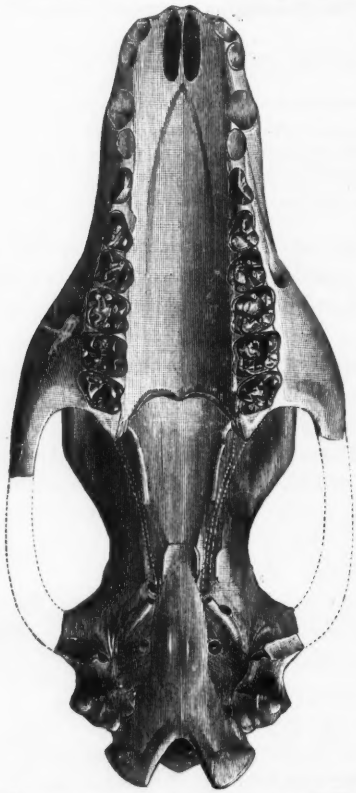
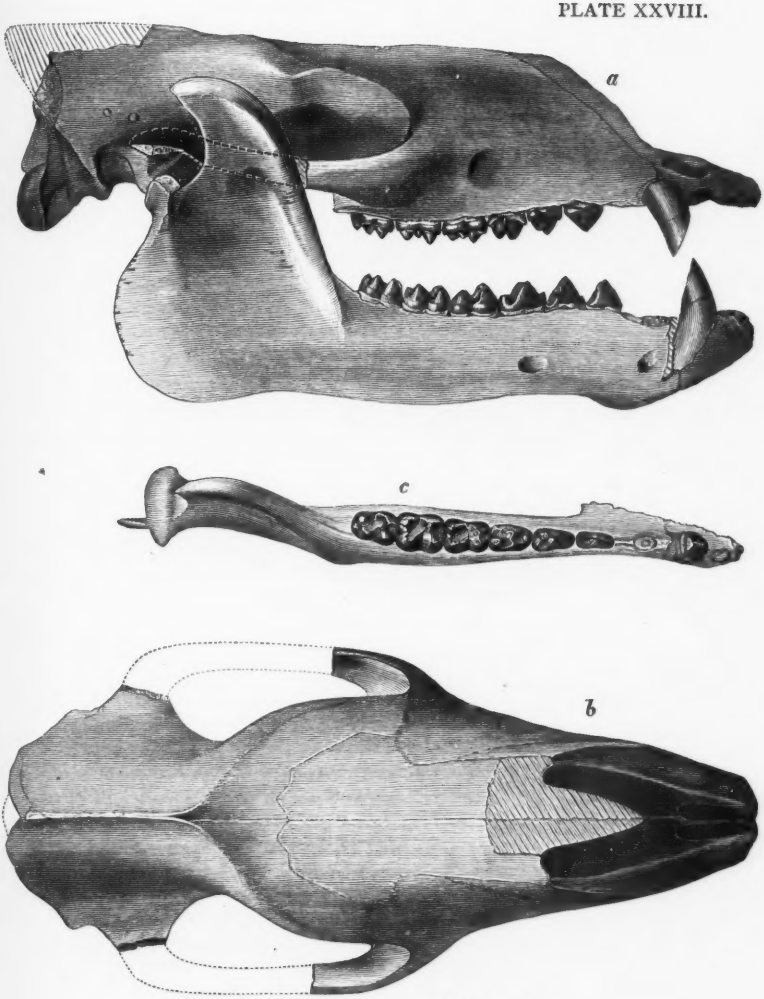


FIG. 15.— *Phenacodus primævus;* skull of specimen represented in Plate XXIX and figs. 17-20; one-half natural size, from below. From Wasatch beds of Wyoming. Original, from Report U. S. Geol. Survey of Terrs., III, F. V. Hayden in charge.

The axis has a cylindric odontoid, and its neural spine is well developed. A vertebrarterial canal. The articular faces of the succeeding cervicals are oblique and slightly opisthocœlous. The second dorsal has rather elongate diapophyses without metapophyses; the neural spine is narrow and rather elevated. The metapophyses are quite elevated on the posterior part of the series, and the centra become somewhat opistho-

PLATE XXVIII.



Phenacodus primævus Cope, one-half nat. size.

cœlous and depressed. No anapophyses on either dorsals or lumbars. The latter have well-developed flat diapophyses, and the centra are keeled below. The postzygapophyses are not revolute, but they become oblique, so that the external parts of the surfaces are nearly vertical. The caudal vertebræ were probably numerous; the proximal have strong transverse processes, and the median are robust in the *P. primævus*. Some of them have chevron bones.

The tuberosities of the humerus (Fig. 16, *b b'*) are as well developed as in tapiroids. The condyle has no intertrochlear ridge, but the cylindrical part is smaller, as in Oreodon, Anoplotherium and Mesonyx. The epitrochlear foramen is a peculiar feature already mentioned. The head of the radius is transversely oval, without inferior interlocking angle. The distal extremity is truncate, and the scaphoid and lunar facets are not distinctly separated. The distal extremity of the ulna is a compressed tuberosity which is produced beyond the radius, to which it is oblique (Fig. 16, *d*).

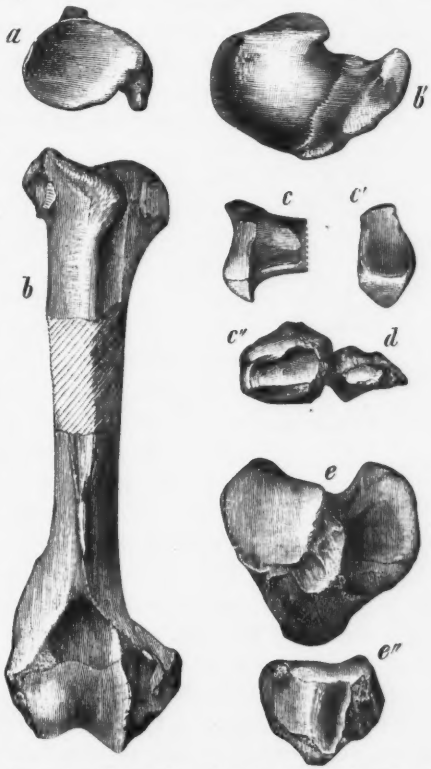


FIG. 16.—*Phenacodus primævus;* bones of specimen represented in Pl. XXIX; a little less than half natural size. Fig. *a*, scapula, glenoid cavity; *b*, humerus from front; *b'*, do. head; *c*, head of radius from below; *c'*, do., proximal view; *d*, ulna and radius, distal view; *e*, tibia, proximal end; *e'*, do., distal end. Original, from Wasatch epoch of Wyoming. From Report U. S. Geol. Surv. Terrs., Vol. III.

The distal keels of the metapodial bones are distinct, but are quite short and entirely posterior.

The pelvis is of normal proportions. The

ilium is not much expanded, but its posterior superior border is thinned out. The anterior border is decurved in front. The peduncle is distinct and rather short, and has a triangular section, the narrower face being anterior and only apparent near the acetabulum (Fig. 18).

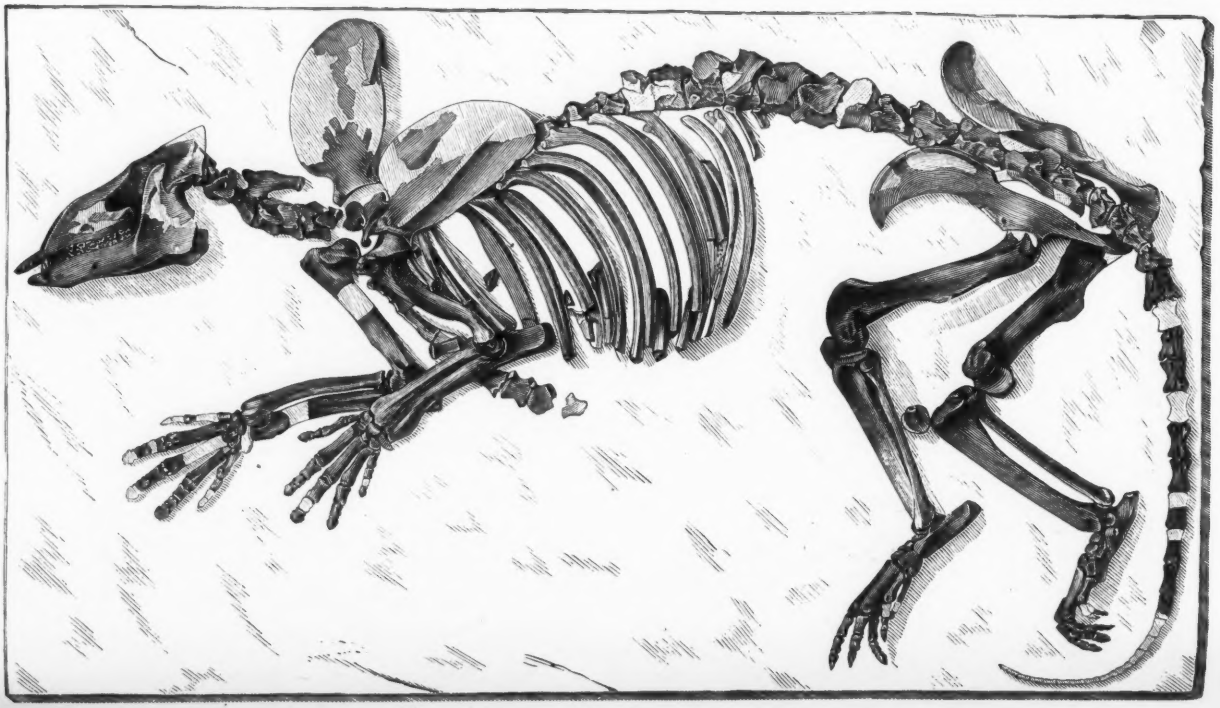
The posterior foot was not entirely plantigrade, but was rather more so than in Tapirus, adding a digit on each side to the three possessed by that genus. These digits are arranged in the arc of a circle, so as not to give unusual width to the foot. The third is longer than the second and fourth, and the fifth is longer than the first. The astragalus has much the form of that of a carnivorous mammal. The lateral crests are well developed and of unequal elevation, the external being the most elongated. The median groove is wide and deep. The neck is distinct, and is rather long, and is bent slightly inwards. The head is transversely oval, and its articular surface is uniformly convex in all directions (Fig. 17). The phalanges are not shortened, and the ungues are well developed, flat and obtuse.

FIG. 17.—*Phenacodus primævus;* carpus and tarsus, one third nat. size, from animal represented in Plate XXIX. Fig. *a*, carpus, proximal view; *b*, proximal view of bones of second row of carpus; *c*, astragalus and calcaneum, distal view; *d*, cuboid and cuneiform bones, proximal view.

It is thus evident that the detailed characters of the skeleton of this genus are as primitive as those derived from the study of the feet and teeth.

A cast of the cranial cavity gives the following as the general characters of the brain: The cerebral hemispheres are remarkably small, each one being less by one quarter than the cerebellum. They are separated from the latter and from the large olfactory lobes by strong constrictions. The posterior one is occupied by a thick tentorium. In like manner a wide groove for a robust falx separates the hemispheres above. A notch represents the Sylvian fissure, and the lobus hippocampi is quite large. The vermis of the cerebellum is quite distinct, and the lateral lobes are large. They are impressed laterally by the petrous bones, as in various ruminants. The anterior columns of the medulla are not visible. There are traces of convolutions on the hemispheres (Fig. 19).

PLATE XXIX.

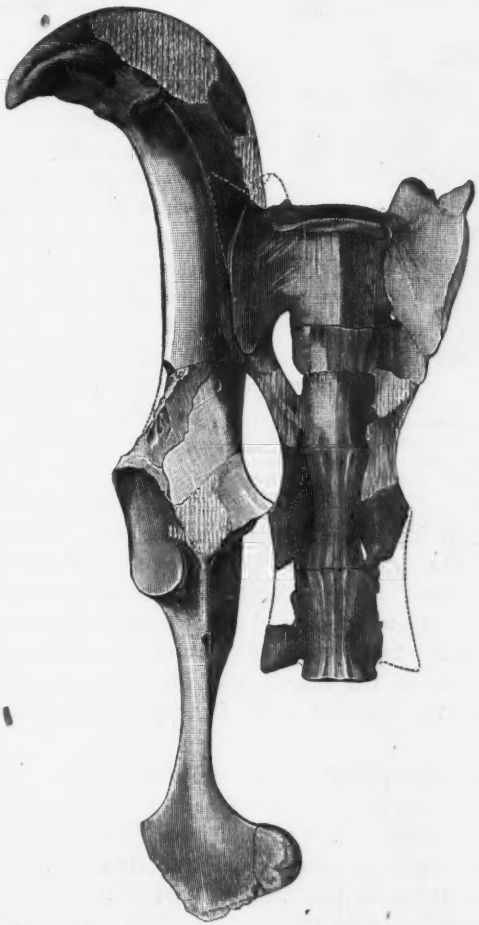


Phenacodus primævus Cope, one-seventh nat. size.

Phenacodus primævus Cope, one-seventh nat. size.

Phenacodus primævus Cope, one-seventh nat. size.

The characters of the brain are very primitive, though the cerebral hemispheres are better developed than in the Amblypoda, which are themselves superior in cerebral structure to the genus Periptychus (Fig. 9).



Phenacodus primævus Cope, one-seventh nat. size.

FIG. 18.—*Phenacodus primævus;* sacrum and right innominate bone minus much of pubis, individual represented in Plate XXIX; one-half nat. size, from below. Original, from Report U. S. Geol. Survey Terrs., Vol. III.

I refer nine species to this genus. Of these only two, *P. primævus* and *P. vortmani* are sufficiently well known to render the

generic reference certain. The others are mostly known from teeth, and it is highly probable that most of them belong to the genus. They are all from either the Puerco or Wasatsch formations—three from the former and six from the latter.

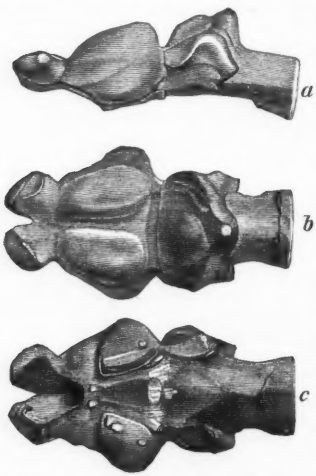


FIG. 19. — *Phenacodus primævus;* cast of brain case of specimen figured in Plate XXIX, one-half nat. size. Fig. *a*, left side; *b*, superior face; *c*, inferior face. Original, from Report U. S. Geol. Surv. Terrs., Vol. III, F. V. Hayden in charge.

The largest species of the genus, the *Phenacodus nuniënus* Cope, was probably as large as the Malayan tapir. The measurements show that the *P. primævus* Cope, was proportioned much as in the common American tapir, but was of smaller size. The middle three toes of both feet reached the ground, while the first and fifth projected laterally and posteriorly, like the dew-claws of the hogs. The tail was longer and heavier than that of any of the living hoofed animals, resembling in its proportions that of the cats. The eyes were small, and the muzzle, though long, was singularly soft above. Whether this soft part was pierced by valvular nostrils, as in the hippopotamus, or was produced into a short proboscis, as in the saiga or in the tapir, cannot be certainly ascertained, but there are indications of the insertion of important cartilages, if not muscles, on the superior faces of the premaxillary bones (see Plate XXVIII).

The animal was probably omnivorous in its diet. It was not furnished with any weapons of offence or defence pertaining to the osseous system, so that it must have sought refuge in flight. The well developed muscular insertions of its limbs, and the digitigrade character of its step, indicate that it may have had considerable speed.

Its bones have been found wherever the beds of the Wasatch epoch occur, but most abundantly in Northern Wyoming. From the Wind River valley Mr. Wortman brought two specimens, and ten from the Big Horn basin. A figure of the skeleton was

published in the NATURALIST, 1883, p. 535, one-seventh natural size, and is here reproduced (Pl. XXIX).

Of the *Phenacodus vortmani* Cope, Mr. Wortman brought portions of four mandibles from the Wind River bad lands, and thirteen from those of the Big Horn (see Figs. 20, 21).

The limbs of this species are rather elongate for an Eocene mammal, and the anterior limbs are distinctly shorter than the posterior. The size of the animal is that of a bull-dog, but the head is smaller and the neck rather shorter, and not nearly so

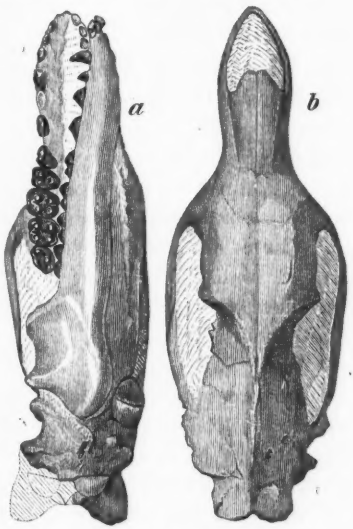


Fig. 20.

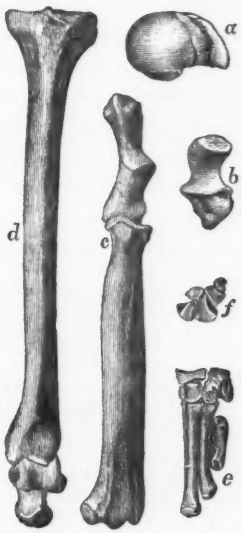


Fig. 21.

FIG. 20.—*Phenacodus vortmani;* skull of individual represented in Pl. XXX, one-half nat. size. Fig. *a*, from below; *b*, from above. The skull is somewhat distorted by pressure. From the Wasatch epoch of Wyoming. Original.

FIG. 21.—*Phenacodus vortmani;* individual figured in Plate XXX, one-half nat. size. Fig. *a*, humerus, proximal view; *b*, do., distal view; *c*, ulna and radius from front; *d*, tibia and astragalus from front; *e*, left metatarsus and part of tarsus, external view; *f*, metatarsus, proximal view, hallux displaced.

robust. The limbs have about the same proportions to the body as those of a bull-dog, but the anterior ones are shorter. The proportions of the parts of the limbs, and of the fore and hind limbs to each other, excepting the feet, are much as in the collared peccary. The feet of the latter animal are longer than in *Phenacodus vortmani* (Plate XXX).

We can thus imagine the *Phenacodus vortmani* as an animal of

the comparatively slender build of the bull-dog, with a neck and head proportioned more as in the raccoon, and with the rump more elevated than the withers, as in the peccary. The feet resembled those of a tapir or rhinoceros, but had a pair of short toes on each side which did not reach the ground. To this add a tail much like a cat's in proportions, and the picture is complete. The diet of this animal was omnivorous, with a smaller proportion of animal food than the hogs, for instance, use. The food is more likely to have resembled that of the quadrumana. What means of defence this species had, is not easily surmised, as the canine teeth and hoofs are not large.[1]

I have named this species after Mr. Jacob L. Wortman, of Junction City, Oreg., whose explorations in the West have been more than usually productive of important results.

The species of the Puerco epoch, of which the superior molars are known, differ from those of the Wasatch in the absence of the small external cingular tubercle which marks the space between the external tubercles. These are the *P. puercensis* and *P. zuniensis* Cope, of which the former is very abundant, and about the size of *P. vortmani* (Fig. 22).

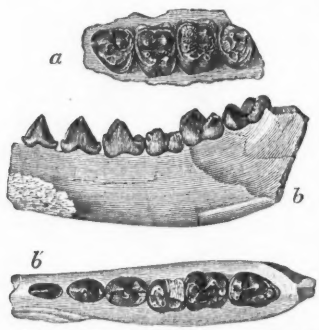


FIG. 22. — *Phenacodus puercensis;* parts of upper and lower jaws, three-quarters nat. size. Fig. *a*, superior molars from below; *b*, left mandibular ramus, external side; *c*, inferior molars from above. From the Puerco epoch of New Mexico. Original.

The molar teeth of the genus Anacodon resemble those of Phenacodus, but the cusps are replaced by flattened surfaces and the valleys represented by superficial wrinkles. They thus resemble somewhat the molars of certain bears. The only species, *A. ursidens* Cope (Fig. 23), is about the size of the *Phenacodus primævus*, and has been found in the Wasatch beds of Wyoming.

[1] I must here observe that in spite of the near resemblance of this species to the *P. primævus* in most respects, it presents two important differences. It has but three instead of four sacral vertebræ, and the ungues are wedge-shaped and not broadly rounded. I cannot avoid the belief that the species should be separated generically from Phenacodus, and therefore propose that the name of Trispondylus be used for the new genus in case its distinction be substantiated.

Diacodexis laticuneus Cope (Fig. 24, *b c*), is a small species, known so far from superior and inferior molars, found in the Big

FIG. 23.—*Anacodon ursidens* Cope, inferior molars from above, three-fourths nat. size. Original; from the Wasatch epoch of Wyoming.

Horn region of Wyoming (Fig. 24). The skull is probably as large as that of a gray fox. If properly placed in this family, it is the most specialized form, on account of the bicuspid premolar teeth.

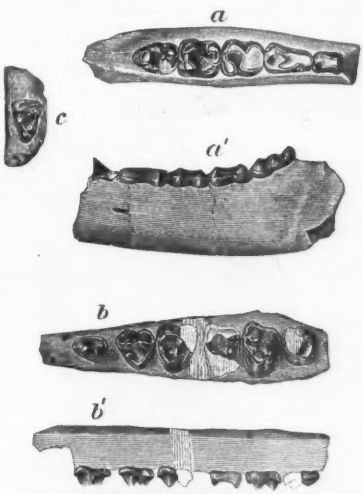


FIG. 24.—Phenacodontidæ, nat. size. Fig. *a*, *Phenacodus brachypternus* Cope, inferior molar from above; *b*, do. with ramus, external side. Figs. *b c*, *Diacodexis laticuneus* Cope; *b*, maxillary teeth from below; *b'*, do. from outer side; *c*, last inferior molar from above. All from the Wasatch epoch of Wyoming. Original, from Report U. S. Geol. Surv. Terrs., Vol. III.

MENISCOTHERIIDÆ.

This family includes the single genus Meniscotherium.

Superior molars with external Vs, and with intermediate tubercles; the latter with the anterior crescentic, the posterior oblique, forming a crest with the posterior inner; anterior inner conic. Inferior molars and last premolar with two Vs; other inferior premolars without internal lobes; fourth superior premolar with two external lobes . . . *Meniscotherium.*

As already indicated, with this genus we enter a new family of the Condylarthra, and one which superadds to its general structure a considerable specialization of the molar teeth. The present genus is the only one of the family yet known, and it is represented by but three species. With present knowledge it must be asserted that the range of this genus was limited both in time and space. The remains of the species have been derived from the Wasatch beds of New Mexico, and from a horizon from near its base which overlies the Puerco. The genus has not been found in any other of the areas of the Wasatch deposits, but it occurs abundantly in its locality, so that it is possible to determine its general structure (Figs. 25–28).

Dental formula, I. $\frac{2-3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$; without diastema. Incisors and canines in both jaws small. The superior molars of this genus have some resemblance to those of Hyopotamus, but the inferior molars are different, and of the Anchitherium type. The temporary last superior molar differs from its successor, the permanent fourth premolar, in its more complex character. It is in fact identical in structure with the true molars. The second and third milk molars differ from their successors in their greater anteroposterior extent. The third has an internal lobe opposite the posterior half of the external wall (Fig. 25, *b c*).

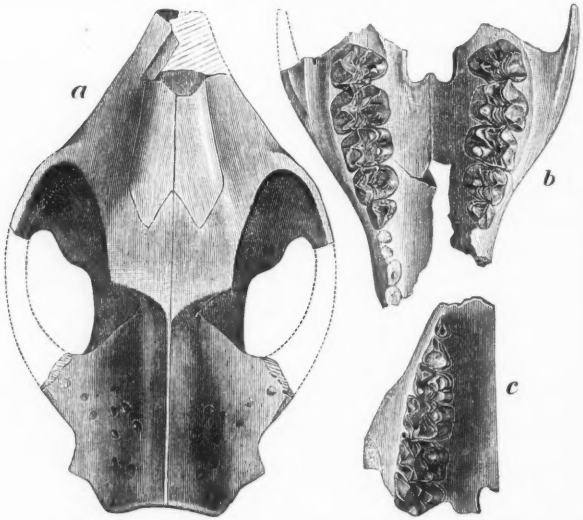


FIG. 25.—*Meniscotherium terrærubræ;* parts of crania, three-fourths nat. size. From the Wasatch epoch of New Mexico. Fig. *a*, cranium No. 1 from above; *b*, do. No. 2 from below; *c*, do, No. 3, displaying deciduous Pm. III and IV from below. Original, from Report U. S. Geol. Survey Terrs., III, F. V. Hayden in charge.

Orbits widely open posteriorly. Palate excavated between the molars posteriorly. A postglenoid process. Auricular meatus widely open below. Post-tympanic and paroccipital processes united. Occipital and sagittal crests. Foramen ovale scarcely separated from f. lacerum anterius. Mandibular symphysis coössified. Mandibular condyle uplooking. Brain not so small as in Phenacodus.

The cervical vertebræ are, like those of Phenacodus, of medium length and slightly opisthocœlous. They, with the lumbars, have

an inferior keel. The disparity in size between the anterior dorsals and lumbars is marked. The odontoid process is cylindric. Metapophyses of lumbars well marked. No anapophyses. Neural canal rather large.

The head of the scapula has a curved coracoid process. The spine rises abruptly from the neck. The humerus is much like that of Phenacodus or a carnivore. The tuberosities are not produced, and there is no external epicondyle. The internal epicondyle is large, and sends upwards the bridge that incloses the epicondylar foramen.

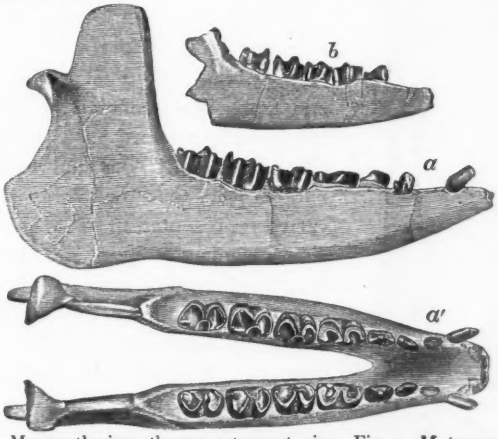


FIG. 26.—Meniscotherium, three quarters nat. size. Fig. *a*, *M. terræubræ*, lower jaw, right side; *a'*, do. from above, the incisor teeth just protruding. Fig. *b*, *M. tapiacitis*, lower jaw right side. All from the Wasatch epoch of New Mexico. Original, from Report U. S Geol. Survey Terrs., III.

The pelvis is not well preserved in the specimens. The ilium shows a rather narrow, triangular narrow, neck, a well-marked anterior inferior spine, an open acetabular groove. The femur shows a fossa ligamenti teris, and the third trochanter on the middle of the shaft, and well developed. The tibia has an anterior crest, and no notch on the antero-external edge of the head. The internal malleolus is a prominent tuberosity, and the astragalar face is scarcely grooved, and is oblique, as in the Creodonta. The distal extremity of the fibula articulates with the sides of the astragalus, but not with the calcaneum. The calcaneum much resembles that of Phenacodus. It is elongate and the astragalar facet is not longitudinal, but is very oblique. The astragalus has trochlear keels of unequal height, and a shallow groove between

them, much less marked than in Phenacodus, but not so flat as in Periptychus. The neck is elongate, and the distal articular surface is convex in every direction (Figs. 27, *d*, 28, *c*).

The number of toes in Meniscotherium is unknown. Metapodial bones preserved are rather narrow, leading to the supposition that the digits are similar to those of Phenacodus and Periptychus. The posterior keels of the distal extremities of the metapodials are distinct.

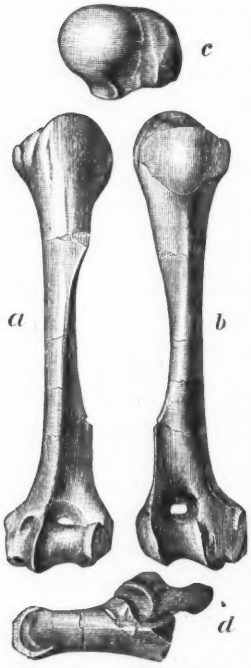
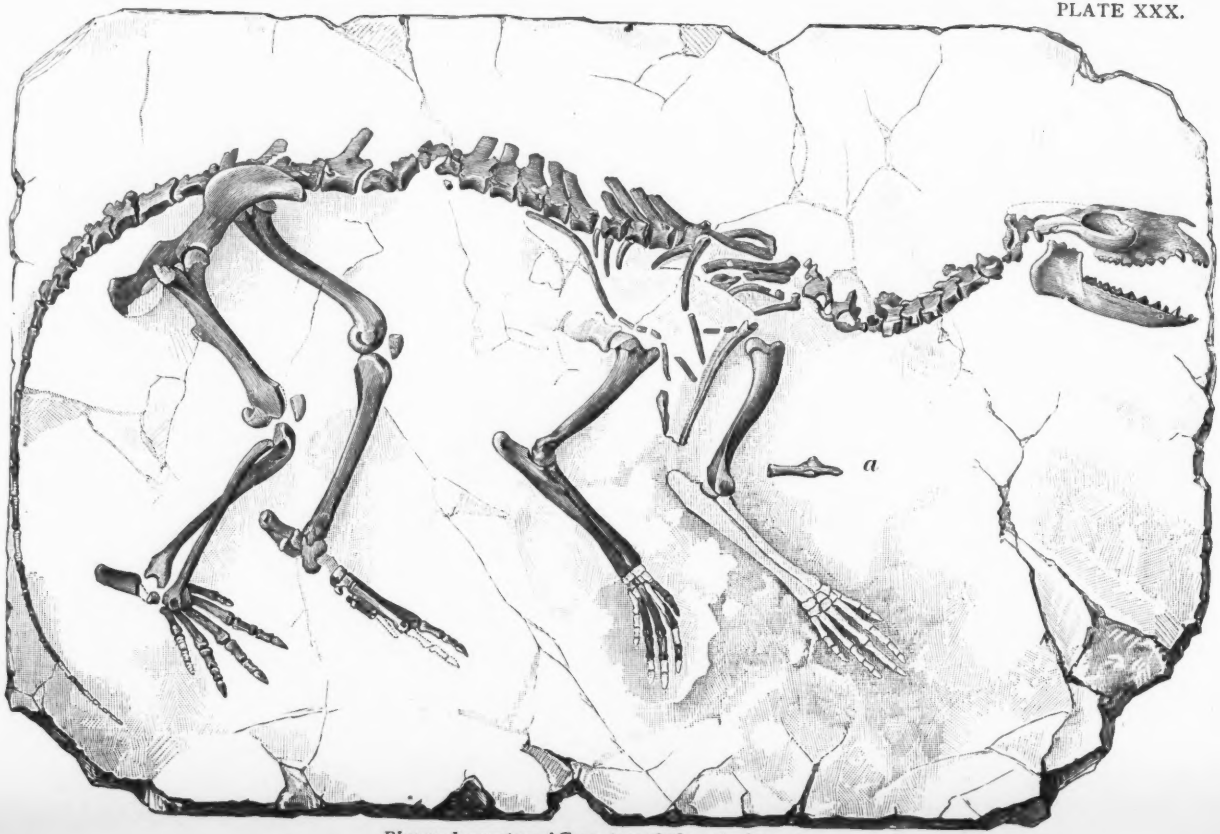


FIG. 27. — *Meniscotherium terræruhræ*; limb bones, nat. size. Fig. *a*, left humerus, front; *b*, from behind; *c*, proximal end; *d*, astragalus and calcaneum of another animal, external side. From Wasatch beds of New Mexico.

This genus is an interesting exemplification of a general truth. That is, that at any given geological epoch a few general types predominate, and that to these few must be referred forms whose varied characters would, on superficial examination, lead to a belief in an equally varied representation of higher divisions. Thus Meniscotherium exhibits a dentition decidedly Perissodactyle, and to that order I accordingly referred it when I originally discovered it. But the evidence of abundant material shows it to be undoubtedly Condylarthrous, and that it enters the same order as Phenacodus. Thus the only possible Perissodactyle has been removed from the Puerco fauna.

Three species of the genus are known, all from the Lower Wasatch beds of New Mexico. The type, *M. chamense* Cope is undoubtedly Wasatch. The *M. terræruhræ* is about the same size. It is about the size of a fox, but with a very different physiognomy. The profile is curved, the muzzle short, and the eyes large. The body is not so slender as in Phenacodus or a fox, having the more robust proportions of a raccoon. The fore and hind legs were rather short, and of equal length, so that the rump was flattened as in the dog. There was a large tail. The species is one-third (linear) larger than the *Hyrax capensis*. It was probably a vegetarian (Figs. 25–26).



Phenacodus vortmani Cope, two-ninths nat. size.

Phenacodus vortmani Cope, two-ninths nat. size.

Phenacodus vortmani Cope, two-ninths nat. size.

The *M. tapiacitis* Cope, is the least species, and presents some dental peculiarities (Fig. 26, *b*).

With this genus and family we close the Condylarthra. That the order gave origin to the Amblypoda is highly probable. Besides this order, the Proboscidea and Hyracoidea must be traced back to it. It stands as the remote ancestors of the Perissodactyla and Artiodactyla, through the Amblypoda. They are the primitive hoofed mammals or Ungulata, and probably existed, like the Plagiaulacidæ, in Cretaceous time.

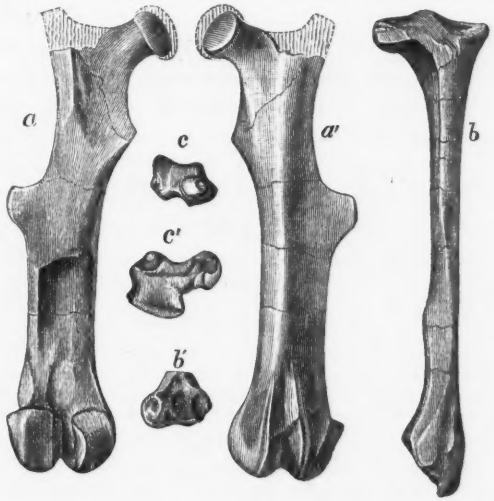


FIG. 28.—*Meniscotherium terrærubræ;* bones of individuals represented in fig. 27, three-quarters nat. size. Fig. *a*, femur behind; *a'*, front; *b*, tibia from front; *b'*, distal extremity. Fig. *c*, astragalus of fig. 27, distal view; *c'*, superior view. From Wasatch epoch of New Mexico. Original, from Report U. S. Geol. Survey Terrs., Vol. III.

The discovery of the Condylartha is a good illustration of what may be derived from persevering scientific research. Prior to this event the history and affinities of the great division of the hoofed Mammalia were, for its earlier stages, a total blank. Few but specialized forms were known, and the affiliations of these with the two aberrant groups of Proboscidea and Hyracoidea, and with each other, could not be guessed. Now the phylogeny is, in the main, certain, and the point of connection with the clawed (unguiculate) orders, not difficult to discern.

Phenacodus vortmani Cope, two-ninths nat. size.

The following table exhibits the distribution in time of the species of the suborder Condylarthra:

PERIPTYCHIDÆ.

	Puerco ep.	*Wasatch ep.*	
Hexodon	1		
Ectoconus	1		
Periptychus	3		
Hemithlæus	2		
Anisonchus	5		
Haploconus	4		
Zetodon	1		17
PHENACODONTIDÆ.			
Anacodon		1	
Protogonia	2		
Phenacodus	2	7	
Diacodexis		1	13
MENISCOTHERIIDÆ.			
Meniscotherium		3	3
			33

EXPLANATION OF PLATES.

PLATE XXVIII.

Skull of *Phenacodus primævus*, from specimen figured in Plate XXIX, one-half nat. size. Fig. *a*, right side of skull; *b*, top of skull; *e*, right mandibular ramus from above.

PLATE XXIX.

Skeleton of *Phenacodus primævus*, one-seventh nat. size; found by Mr. J. L. Wortman, and mounted by Mr. J. Geismar. From the Wasatch beds of the Big Horn river, Wyoming. (This plate was published in the NATURALIST, 1883, p. 535, and there erroneously stated to be one-fourth natural size.) Mus. Cope.

PLATE XXX.

Skeleton of *Phenacodus vortmani*, two-ninths nat. size, found by Mr. J. L. Wortman in the Wasatch beds of the Big Horn river, Wyoming, and mounted by Mr. J. Geismar. Mus. Cope. Fig. *a*, *manubrium sterni*.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The use of trinomial nomenclature in biology has been revived in the United States during the last ten years, and its adoption has been easy because it supplies a want. Subspecies are often very recognizable, as are in fact species which inosculate with other species at the present time, so as to be inseparable by definition. For the recognition of such forms the trinomial nomenclature is indispensable.

All the innovations in nomenclature from this side the water

have not been, in our opinion, so happy. We note four such which have not been generally adopted, though they have advocates in some quarters: (*First*) The type of a genus shall be the species which stands first on the list made by the original describer. This method has been generally discarded, and the law of exclusion been adopted in its stead. That is, the species remaining after others have been subtracted as representing new genera, bears the earliest generic name. (*Second*) When an existing specific name has been used for a genus, the same name shall continue to be used for the species instead of a new one. There result from this method such names as *Sialia sialis*, *Mephitis mephitica*, *Calamus calamus*, *Scomber scomber*, etc. It would seem superfluous to object to such names were it not that they have advocates. Dr. Lydekker's assertion that they are "ridiculous" seems to us to cover the ground. We know of no argument in their favor. (*Third*) Any generic name which is attached to the description of a species shall be regarded as the generic name of that and other congeneric species, whether such genus has been defined or not. This proposition has been negatived by the almost entire vote of American naturalists who responded to the circulars of the Dall committee on nomenclature of the American Association for the Advancement of Science for 1877. Nevertheless some American naturalists adopt such *nomina nuda*. (*Fourth*) That a name once used cannot be used again, though it be an evident synonym. To discard a name because it may be found in some list of synonyms seems to us to be increasing rather than diminishing confusion. To put the present system of nomenclature through a process of renovation such as this proposition requires, would be impracticable. Hence we disapprove of such names as Zapus, Amphisaurus, etc.

We add a consideration respecting the adoption of the names of higher groups, as families, orders, etc. We propose the following rules as agreeing most nearly with present practice, and as fulfilling most nearly the object of all rules, the securing of justice to persons concerned. We propose that names of all divisions higher than genera:

I. Be only adopted when accompanied by a definition.

II. That they be preserved for the division for which their original proposers intended them as nearly as possible.

NOTE.—What their proposers intended them for can as often

be learned from the contents of such divisions as from the definition, since in early stages of the science definitions are always defective. This rule will be definitive of the action of the law of priority which is now often neglected in the case of the higher divisions.

—— Good illustrations are an important part of scientific literature, and in some of the departments essential. This is especially true of embryological and histological work. The difficulty encountered in the United States is the comparative expensiveness of the ordinary processes. For several years American naturalists and institutions have been seeking for cheaper methods. The Smithsonian Institution and the National Museum have been especially active in this work, doubtless with the excellent object of securing the greatest good to the greatest number. There are many phototypic processes, and many of them have been tried. We are sorry to have to confess that the results have not been as successful as has been hoped. These processes do well enough for fugitive literature, but for permanent scientific work they are rarely good. In the case of line drawings the metal appears to be too soft, and breaks more or less during the process of manufacture. The strong shades of direct photography will forever, we fear, prevent their displaying surfaces clearly, except in the medium lights. The alternative seems to be to endeavor to secure the best illustrations at cheaper rates than are now paid. If we do not do so, there are strong symptoms that the best American work will seek European channels of publication.

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RECENT LITERATURE.

BIOGEN, BY DR. COUES.[1]—The present 12mo volume consists of a lecture delivered before the Philosophical Society of Washington, with introduction, preface and a liberal appendix. In the Preface we find a narrative account of the reading of the paper, and the criticisms, with elicited comments thereon. The Introduction is an extract from the official record of the meeting of the society on the same occasion. The first is written in Dr. Coues's graphic and entertaining style. The lecture itself is agreeable reading. As to the philosophy of the lecture, it may be summarized thus: As a biologist and familiar with animals, Dr. Coues perceives more in life than unintelligent forces, and he insists on its essential diversity from them. To sustain this position he cites many of the arguments usually adduced on this side of the question, some of which are very pertinent, but none of which are conclusive. However, towards the end of his remarks he takes the real and impregnable position of the vitalists, in the

[1] Biogen. Speculation on the origin and nature of Life. By Professor Elliott Coues. Boston: Estes & Lauriat, 1884.

phenomena of consciousness and mind. Had Dr. Coues been contented to let his case rest here, he could not have been answered. But he goes further, and discusses that difficult problem, the relation subsisting between mind and matter. He here commits the usual error, the confusing of *attribute* with *substance*. He talks about "mind-stuff" and "soul-stuff" and denies it the qualities of matter. His immaterial matter he calls Biogen. "Biogen" he says (p. 55), "itself of course is alive, it *is* life; and biogen may be defined as spirit in combination with the minimum of matter necessary to its manifestation." The best way to exhibit the fallacies involved in this sentence, is by a paraphrase viz: Heat of course is in motion, it is motion; and heat may be defined as motion in combination with the minimum of matter necessary to its manifestation. The appendix is chiefly devoted to an exposition of this doctrine.

Professor Coues's arguments for the distinctive importance of "mind in nature" are excellent; and his reasons for believing that the chemical constitution of protoplasm is not all there is of life, are weighty. It is when he tries to wed mind and matter that he falls into the difficulties that have floored many others before him, on both the materialistic and idealistic sides of the question.

Barrois' Palæozoic Formations of Asturias and of Galicia.[1]—Asturias and Galicia, we are told by our author, form for the naturalist one region, bounded to the south by the Cantabrian chain, some of the summits of which rise above 2500 meters. From these mountains to the ocean extend series upon series of ridges, separated by profound transverse valleys, and well forested. The steep slopes render the heights difficult of access in the south, and in the center the vegetation masks the strongly inclined coal beds. These Asturian mountains are rich in iron, zinc, mercury, manganese, cobalt, and coal, and on account of these riches more than sixty geologists, commencing with P. Gaspar de Ibarra in 1644, have written upon the province of Oviedo.

After an enumeration of these memoirs M. Barrois attacks the lithology of the sedimentary rocks, of which Asturias is almost entirely composed, the eastern part consisting of limestone, the western of schists and quartzites which lie directly upon the archæan crystalline schists of Galicia. The plutonic rocks consist of granites, quartziferous porphyry, diorites, diabase, and recent quartziferous kersantites.

The fossiliferous horizons of the region are almost exclusively calcareous, and it is thus easy to draw a parallel between the Devonian and Carboniferous faunæ. No foraminifera have been noted in the Devonian limestones; madrepores, and especially

[1] Recherches sur les Terrains Anciens des Asturies et de la Galicie, par Chas. Barrois, Lille, 1882. Ouvrage accompagné d'un Atlas de 20 planches.

reef-corals, are common in both Devonian and Carboniferous, but other orders of Anthozoa are rare or absent. Crinoids are absent in the Silurian of Asturias, but the Devonian furnishes genera identical with those of the Rhine, and the Carboniferous is rich in species. Echini occur in the Carboniferous, but have not been found in the underlying formations. Bryozoa occur in both Devonian and Carboniferous, and 112 species of Brachiopoda are enumerated by our author in the three formations, by far the greater part of them from the Devonian. The Lamellibranchiata Asiphonida are better developed than the other divisions of bivalves, and the Gasteropoda Siphonostomata are entirely absent.

Cephalopoda, so greatly developed in adjoining countries, play an insignificant role in Asturias; and the crustacea are limited to trilobites, one ostracodous carboniferous species excepted.

The sixth chapter treats of the earth-movements, denudation, etc., which have modified the palæozoic strata since their first appearance.

This volume, remarkable in itself as a monument of research, becomes still more so when the multiplicity of the labors and comparative youth of the author are considered.

FRIEDLÄNDER'S BIBLIOTHECA HISTORICO-NATURALIS ET MATHEMATICA.—This is a bulky strongly-bound octavo volume apparently of upwards of a thousand pages, which afford good evidence of the great demand made by scientists for the separate reprints of special papers, and of the success to which the Friedländers have attained in meeting this demand. To what an extent natural science has become specialized may be learned by glancing through this series of catalogues. Another fact of interest is the great disproportion between the number of general works and that of special papers, notes, brochures and memoirs. The practice of having a few reprints struck off for private distribution among one's scientific friends and correspondents has proved one of the highest value to those engaged in special lines of research. Such "separata," "reprints," "extras," as they are variously termed, find their way, after the death of their owners and the dispersal of their libraries, by means of the second-hand book-dealers, into the hands of specialists of a later generation, and thus crop after crop of papers are handed down in series of intellectual ancestry. The Cuvier or Von Baer of the old world, when he dies, bequeaths, in this indirect way but by a sure title, his intellectual works to his European or even transatlantic heirs engaged in the same line of study as his prototypes of the first years of the century.

The book is illustrated by a portrait of the founder of the firm, Julius Friedländer, who traveled in the United States, whose doctor's dissertation was a mathematical thesis, and among whose Berlin friends was Alexander Humboldt. He died in 1882.

The catalogues are separately paged, and the system of classification is a natural and convenient one, beginning with the history of zoölogy, "Miscellanea zoölogica," zoö-geography, faunæ, comparative anatomy, including embryology and morphology, as well as "Darwinismus." A separate catalogue is devoted to man, and nearly each large class of the animal kingdom has a separate catalogue. So with the vegetable kingdom; then follow the lists of works relating to palæontology, geology, mineralogy, etc. The catalogues are not of course designed to be complete bibliographies, but represent the enormous stock carried by the firm. At the same time not only is such a catalogue useful to libraries and bookbuyers, but it is valuable for reference by specialists.

BESSEL'S SMITH SOUND AND ITS EXPLORATION.—This is both a timely and authoritative essay, which the learned and experienced author has compiled from a long list of authors whose works are enumerated at the end of the brochure. As the compiler and editor of the voyage of the *Polaris* had only a few meager journals and a log-book at his disposal, Dr. Bessels has dwelt at length on that voyage, frequently using entire passages from his own narrative, the map being a photo-lithographic reproduction of that contained in his "Amerikanisch Nordpol Expedition."

At the close of the essay Dr. Bessels remarks that "the position of Greely and his party is not a dangerous one, although it is critical. He probably has provisions sufficient to last until the autumn of 1884, without taking the fourteen musk-oxen into consideration; these, according to his own statement, would provide him and his men with meat for seven months, even though issued as often as three times a week. Captain John Ross, not as well equipped as he is, spent four consecutive years in the Arctic regions, and still made good his retreat; but at the same time we must not forget that he wintered in lower latitudes, where the sun is not so long below the horizon as in Lady Franklin bay."

Finally he claims that we should not be disheartened by the failures in Arctic explorations of the last few years. "Arctic exploration, like warfare, has in the course of time fairly become a science, and the danger of now wintering in high latitudes is much less than it was twenty years ago." He adds that "our knowledge of the distribution of land and water in the vicinity of the Poles is almost as imperfect as it was at the time when Cook made his memorable voyage towards the South Pole, and when Forster, his scientific companion, tried to convince him that the vast ice-floes obstructing their passage were not of meteoric origin." The essay is reprinted from No. 30 of the Proceedings of the U. S. Naval Institute.

LECHE'S ANATOMY OF THE PELVIC REGION IN THE INSECTIVORA.[1]—In this work the osseous, nervous, and muscular anatomy of the pelvic region of many species of insectivores is fully considered in about a hundred pages of text, and illustrated with ten well-executed plates. The examples described include Galeopithecus, two species of Tupaia, a Macroscelides, *Parasorex socialis*, *Erinaceus europaeus*, *Centetes ecaudatus*, *Hemicentetes variegatus*, *Ericulus nigrescens*, both forms of Myogale, Urotrichus, three species of Talpa, *Condylura cristata*, *Scapanus breweri*, two forms of Sorex, *Crossopus fodiens*, *Blarina brevicauda*, three kinds of Crocidura, and *Chrysochloris inaurata*. Thus every family of Insectivora is represented, excepting the Myrhomyidæ and Solenodontidæ. The os acetubuli or fourth bone of the os inonminatum is figured in various carnivores and rodents as well as in insectivores, and is stated to be present in marsupials and edentates. This bone was first noted by Cuvier, and called by him "os cotyloidien," but has since been very generally ignored by naturalists.

GAUDRY'S "LES ENCHAINEMENTS DU MONDE ANIMAL."[2]—Though this able and eloquent French palæontologist states that the aim of all researches among extinct forms is to find the plan of creation, he yet admits the evolution of the animals of one epoch from those of the preceding, and believes that the full scheme of life-development will one day be discovered. The various classes of articulates, fishes and reptiles, are reviewed with the purpose of bringing into prominence the relations which connect the extinct fauna with each other and with recent forms.

But while our author admits that the passage from species to species, genus to genus, and family to family is fully proved, he states that palæozoic fossils have not yet furnished positive proof of the passage of animals from one class to another, since the principal classes of marine invertebrates were present in the Cambrian, and the Permian reptiles are as unlike fishes as possible.

REPORT OF THE U. S. COMMISSIONER OF FISH AND FISHERIES FOR 1881.—This bulky volume is not inferior in size to any of its predecessors in the series, and in fact is rather thicker, numbering 1146 pages. Nearly half the volume is occupied with materials for a history of the mackerel fishery by Messrs. Goode, Collins, Earll and Clark. The purely scientific portion is devoted to a list by Professor H. E. Webster and James E. Benedict, of the chætopod worms discovered at Cape Cod, nearly twenty new species being described and figured. Mr. John A. Ryder reports on the protozoa and protophytes as the primary or indirect source

[1] Zur Anatomie der Beckenregion bei Insectivora mit besonderer Berücksichtigung ihrer morphologischen Beziehungen zu derjenigen anderer Saügethiere, von Wilhelm Leche. Mit 10 tafeln. Stockholm, 1883.

[2] Les Enchainements du Monde Animal dans les temps geologiques. Fossiles primaires. Par Albert Gaudry, Paris, 1883.

of the food of fishes; also on the retardation of the development of the eggs of the shad, a very interesting essay; and Mr. H. J. Rice also writes upon the same subject, while Mr. S. A. Forbes reports on the first food of the common whitefish, which consists of the smallest species of Entomostraca.

THE WOODS AND TIMBERS OF NORTH CAROLINA.—This is a compilation by P. M. Hale, from the botanical and geological reports of Drs. Curtis, Emmons and Kerr, to which are added information obtained from the Census Bureau, with reports from the several counties. A recent visit shows great improvement in the business activity and condition of the State. The Agricultural Department, by its museum and timely, authoritative publications like the present and others elsewhere mentioned, is doing a great deal in making the forests and mineral resources of the State better known, both at home and abroad. North Carolina is famous for its vast forests, and this hand-book is an interesting and valuable résumé of the characteristics and distribution of the forest trees of the State. The book owes its value largely to the original report of the Rev. Dr. Curtis printed in Emmon's Report on the Geology of the State, and reproduced in full.

A BOTANIST'S VACATION.[1]—A delightful little book from the pen of the genial Professor of Botany in the University of Pennsylvania reaches us just as the annual longing for rest and recreation comes to every brain-worker. It is a sermon in the gospel of relaxation, and it is so well preached that every reader will want to get a boat and follow the sailor-botanist down and up and across the Chesapeake and Delaware bays. There is a good deal of botanical inspiration in the book, and it is well worth reading by any one proposing to take a few week's run on the water. —*C. E. B.*

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[1] *Vacation Cruising in Chesapeake and Delaware Bays.* By J. T. Rothrock, M.D., Professor of Botany in the University of Pennsylvania. Illustrated. Philadelphia, J. B. Lippincott & Co., 1884. 12mo, pp. 262.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AMERICA.—*The Greely Expedition.*—It is impossible to give in the NATURALIST a full account of this unfortunate yet successful expedition, but the following abstract will cover the principal features of its history, as known up to the present time. The four miles advance towards the Pole has been secured at a loss of nineteen lives, including that of the leader of the advance party. Fortunately for the cause of science, the whole of the records and instruments of the expedition have been saved. The health of the entire party during their two years' stay at Lady Franklin bay seems to have been excellent, and this, taken along with the experience of the crew of the *Eira*, goes to prove that scurvy and other diseases usually thought to be incident to an arctic climate can all be avoided with suitable clothing, proper and abundant food, and a good, well-warmed house, if proper discipline is maintained. It is said that the scientific work done by this expedition far surpasses in importance, completeness and scope that accomplished by any other. This is not the place to enter into a criticism of the actions of the leaders of the two relief expeditions which so signally failed to accomplish their purpose. Through their failure nineteen valuable lives have been lost, and had not Commander Schley acted with the utmost alertness and promptitude, forcing his way onward even at the risk of grounding on the ice, not a man would have been saved. Forty-eight hours more would have completed the destruction of the entire party.

Results show that it would have been better had the party remained at their station, where they appear to have had plenty of provisions and abundance of game, but their expectation was to find a sufficient supply of provisions cached for them by the expeditions which had failed to reach them, and they could not know

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

that relief was on its way. The surprise and disappointment experienced when they found themselves without efficient protection and with totally insufficient provisions, compelled to endure the rigors of a third winter, must have exceeded anything that can be conceived by those who did not share the experience. Reduced to feed on seaweed, rock-lichens, sealskin and shrimps, of which latter the supply was very limited, it is no wonder that they gradually weakened and died. Sergeant Cross died in January, in April he was followed by Christiansen (half-breed), Edwards (Eskimo), Lieutenant Lockwood and Seargeants Linn, Rice and Jewell; four others died in May, and seven in June, including Dr. Octave Pavy, the surgeon of the expedition, and Lieutenant Kislinburg. Dr. Pavy was an experienced Arctic traveler. He took part in an expedition sent out by France, then spent several years among the Eskimos in Lady Franklin bay and Grinnell Land; next formed one of the members of the Howegate expedition, and lastly joined the party commanded by Lieut. Greely. He was born at Havre, France.

AFRICA.—*Madagascar.*—This island, according to M. Alf. Grandidier, was discovered by the Portuguese on the 10th of August, 1500, instead of, as usually stated, the 1st of February, 1506. It was well known to the Greeks and Arabs, and, spite of the doubts of commentators, arising from ignorance of the regularity of the winds and currents and the usages of local navigation, it is doubtless the Menuthias of Ptolemy. The number of days' journey given by this author, when compared with that reached by the boats now navigating these seas, and with the details given by Arrian respecting the aspect and productions of Menuthias, are conclusive as to its identity with Madagascar. The Pyralaos or volcanic islands must be identified with the Comoro islands. Maçoudi mentions Madagascar under the name of the land of Djafouna, and Edriji, in his "Nozhat Almoschtak" marks it upon a planisphere (date 1153), under the name of Chezbeza, by the side of a group of islands which, from the accompanying description, are the Comoro islands. M. Grandidier has made a *fac simile* of this planisphere, the most ancient known map on which Madagascar is shown. The first planisphere which gave an exact idea of the position and configuration of this large island was that of Salvat de Pilestrina, dated 1511. The maps of Apres de Mannevillette (1770), and Owen (1825) gave the coasts with tolerable exactitude, but the disposition of the mountains, the river-courses and the forests were unknown previous to the explorations of M. Grandidier himself. Until 1871 all the geographies showed Madagascar as intersected from north to south by a great chain of mountains sending east and west ramifications, separated by wide valleys, while the entire area was forest-covered. The facts are widely different. The entire eastern part of the island is occupied by a much disturbed mountain

mass, the watershed of which is not very distant from the Indian ocean; while the forests form a continuous girdle, only a few leagues in width, concentric with the coast and surrounding a vast area which is entirely without trees, and in its mountainous portions, that is to say, throughout two-thirds of its extent, is even without shrubs. The western part of the island is flat.

Cosmos gives an account of Captain Crema's journey in Morocco in 1882 with a map which corrects many defects in previous maps, and supplies many omissions. In the same issue G. Bianchi gives an account of his explorations in the Gurageh territory in 1880, with a map of the Galla territory south and east of Shoa.

The Aruwimi.—It is known that the Congo, at the head of its bend to the north of the equator, receives a great tributary, the Aruwimi, from the north-east, but the course of this river is still unknown. A large river called the Welle, with numerous tributaries, the Gadda, Gurba and the considerable river Bomokandi, has been thought to be the Aruwimi, but Dr. Junker hopes to be soon able to adduce proof that it belongs to the system of the Shari, flowing into Lake Tchad, while he feels inclined to identify the Nepoko, a large river with numerous tributaries bordered by vast treeless swamps, with the Aruwimi of Stanley.

Asia.—*The Nan-schan Mountains.*—The explorations of Col. Przewalsky in the north-eastern part of Thibet have unraveled the complications of the mountain-chains of this region. The Kuen-luen mountains stretch, under various names, from Yarkand into the interior of China proper, but it is only in their western part that they form the northern boundary of the Thibetan highland, separating it from the low-lying desert of Tarim. Farther east the rim of this highland is double. The Tugus-daban connects the Kuen-luen with the colossal Altyn-tag to the east, and the latter is again connected with the still more easterly Nan-schan. Enclosed between the Kuen-luen and the northern mountains are the basin of the Koko-Nor and the ring-like plateau of Tsaidam. The Nan-schan consists of at least three parallel ranges and forms an alpine region of considerable width, broadest north and north-west of the Koko-Nor and at least forty versts wide in the meridian of Ssa-tcheon. Ssa-tcheon, situated in an oasis, is the chief town of the north-westerly prolongation of Kansu that extends between Mongolia and Thibet. Col. Przewalsky has given names to the subordinate ranges, one of which, the Humboldt, has summits at least 19,000 feet in height. Nowhere in the world is a greater contrast to be found than that between the two sides of this huge mountain rim. On the northern face of the Nan-schan extends a broad plateau 5000 to 7600 feet above the sea, with a vegetation of Ephedra, Haloxylon, Nitraria, Calligonum and *Artemisia campestris*, like that of the desert. The Nan-schan mountains are rich in gold, as are also the sands of the Dan-he river, which rises on their slope.

The Thousand Caves. — Col. Przewalsky, in his account of the Nan-schan mountains on the confines of Mongolia and Thibet, describes the "Thousand Caves" excavated by the Buddhists in a ravine lying between the sand desert and the mountains. These caves form two irregular rows, one above the other, excavated in the precipice. At the southern end a third row comes in. The lower row communicates with the upper by steps. Here, in the space of a verst, are many hundred caves, large and small, few of which remain uninjured. These caves were excavated under the Han dynasty. Walls and vaults were once covered with plaster and adorned with mosaics, and in some places remains of the larger images exist. Each of the smaller caves is from twenty-eight to thirty-five feet long, twenty-one to twenty-eight wide, and twenty-eight high. The larger caves have twice these dimensions, the figures in them are sometimes twice the natural size, and in their center stands a colossal figure upon a pedestal, surrounded by smaller figures. Two of the largest of these colossi are Da-fu-jan, eighty-five to ninety feet high, and some forty-five feet wide, with feet twenty-one feet in length, and forty-two feet apart between the great toes; and Dsho-fu-jan, which is about one-half these dimensions. In two of the caves there are upon the walks colossal idols in a recumbent position; one of these, called Schi-fu-jan, is surrounded by his seventy-two children. The head, the hands which are clasped over the breast, and the bare feet of this figure are gilded, and the garments striped with red. These figures are finished off with a mixture of clay and chopped reeds. At the entrances of the larger caves, and sometimes in the interior, are representations of heroes, often with grotesque or animal faces, and with swords, snakes, etc., in their hands. In one cave such a hero is mounted upon an elephant, while in another a similar figure rides upon a fabulous beast.

The Pamir.—The Proceedings of the Royal Geographical Society (March, 1884), give a map illustrating the Russian explorations in the Pamir, the "Roof of the World," and highest region of central Asia. The map is compiled from that of Dr. Regel and others, and includes the discoveries made by Captain Putiata, M. Ivanoff, and M. Bendersky, of the Pamir Expedition fitted out last year by the Russian governor of Turkistan. The upper courses of the Murghab, Great Pamir, and Khund, all tributaries of the Pandj, are clearly shown, and several lakes indicated. The Aksu is the head-stream of the Murghab.

Central Arabia.—M. C. Huber, already known from his travels in Central Arabia, is now at Haïl, the capital of Jebel-Schommar. Ibn Reschid, emir of this region, has recently defeated Abdallah Ibn Saoud, the heir to the Wahhabite throne. M. Huber, who was escorted from Damascus by three horsemen sent for that purpose, and is lodged in one of the finest houses of the capital, has collected much geographical information, and has obtained a

hundred new inscriptions. He is about to depart to determine the position of the mountain mass of Jebel Agée, and proposes to traverse the entire Hedjaz. The results of his first journey are in preparation for publication by the Geographical Society of Paris.

The Aral.—M. Konshin states as the result of his explorations that the immense depression of Sara-kamysh, in some places 280 feet below the Aral, formed in a geologically recent time one basin with that lake. The fossils of this depression are identical with species found in the Aral and Caspian lakes and show that its waters were brackish or salt. The lake had an outflow into the Caspian.

China.—M. Hosie, who has made a journey of nearly 2000 miles from Chung-King in Szo-chuan to Cheng-tu, capital of that province, and thence by Tali in Yunnan to Yunnan-Fu, returning by another route, states that the European maps of these districts are exceedingly defective, although fairly good native maps can be procured.

GEOLOGY AND PALÆONTOLOGY.

The Protoconch of Cephalopoda.—The accepted divisions of the Cephalopods have been founded by authors wholly upon characteristics of the adult form of the shell, whether straight, as in Orthoceras, curved, as in Cyrtoceras, coiled up with open whorls, as in Gyroceras, or with the whorls in contact, as in Nautilus. These modifications, together with the outlines of the aperture and other minor characteristics, have, heretofore, determined the group to which any given shell was referred.

The examination of the young of all the closely coiled Nautiloidea shows them to be as a rule uncoiled, and in the earliest stages simply arcuate as in the adults of the group of the Cyrtoceratites, and having a scar on the apex which represents the beginning of the stage in which the animal commences to construct the true or secondary shell. The young of all the Ammonoids have, on the contrary, with the marked exception of some palæozoic species and some *varieties of species*, closely coiled whorls at the corresponding stage of growth, and upon the apex is a tiny bag or embryo shell, which has been very appropriately called the protoconch by Owen.

In my Embryology of Cephalopods, Bulletin of Museum of Comparative Zoölogy, Cambridge, No. 5, Vol. III, the position was taken that the scar of the Nautiloidea showed that a protoconch had existed in the embryo of Nautilus, but had disappeared during the growth of the shell, the scar being uncovered by its removal. This supposition was endorsed by Professor Richard Owen, but rejected by Barrande, who insisted that the general absence of a protoconch was a fatal objection. There exists, however, on the apex of some Orthoceratites, an excrescence or

bulb of a withered and somewhat irregular and variable shape. De Koninck, in his magnificent work upon the "Calcaire Carbonifere de Belgique," curiously cnough cites these very forms as the principal proofs against my conclusion, because in them the scar is absent. According to my examinations and drawings, however, the scar ought to be found in such examples underneath the bulb of the apparently complete apex, which is simply the withered and shrunken remains of the primitive protoconch. This was evidently originally a soft, embryonic shell, composed of conchiolin, and not of calcareous matter as in the Ammonoidea. I have seen and figured several examples in which a bulb was present on the apex and no scar visible, and one case in which the bulb (protoconch), had evidently been taken away, leaving the scar visible below, surrounded by the broken edges of the outermost shell layer, which formerly connected the apex with, and covered the protoconch. The external layer of shell and its longitudinal ridges from the apex up, on to the so-called plug of the cicatrix described by Barrande, have also been traced, and thus every point in the evidence appears to be complete, and the fact that the bulb is covered by a true protoconch continuous with the shell of the apex seems to be established.—*Alpheus Hyatt.*

Fossil Man in Mexico.—Dr. Mariano Barcena, director of the department of Geology and Palæontology of the National Museum of Mexico, recently discovered the facial and mandibular parts of a human skull in a hard rock not far from the city of Mexico. The specimen was found in a hard siliceous limestone near the border of Lake Texcoco, at some elevation above the level of the water of the lake. Overlying the bed of limestone, is a lacustrine deposit, which is similar to that made by the present lake, and contains the same mollusca, etc. Whether the limestone be a still more ancient deposit of the lake, has not yet been determined by Dr. Barcena, but the overlying deposit indicates the former wider extension of its waters. It is also evident that since the entombment of the human skull, both deposits have been elevated several feet, and separated from the part now under the lake by a fault. This was probably accomplished at the time of the projection of an eruptive hill near the locality. Dr. Barcena, from whom the above statements are derived, will shortly describe the characters of this interesting specimen.

Geology of Algiers.—*Tertiary.*—The three tertiary stages, say M. Peron, can usually be easily distinguished in Algiers, for they present themselves in isolated and independent masses. The systems of upheaval of the Pyrenees of Corsica and Sardinia, and of the western Alps, have all played an important part in Algiers, and have so separated the tertiary areas as to render their classification relatively easy. The eocene is in many places absolutely without fossils, and in most others offers nothing to the palæon-

tologist but immense numbers of nummulites. Sandstone is the chief constituent, but there are thick bands of claystones, flint, gypsum, etc. The total thickness cannot be less than 400 meters. This formation is the most important factor in the mountains of the Tell, and a multitude of summits are composed of the sandstones and nummulitic limestones. It is superposed on various formations, and is usually highly unconformable with the stratum on which it rests. The eocene appears in two interrupted belts parallel to the coast, one in the Tell, the second in the north of the high plateaux. It does not occur in the south, and is more developed in the east than in the west. The miocene, on the contrary, is most developed in the west, and, though frequently composed of rocks very similar to the eocene, can usually be distinguished by its highly fossiliferous character. In the department of Constantine part of the deposits are lacustrine or fluviatile. Miocene strata occupy large areas in the Tell, apparently filling depressions produced after the deposit of the eocene, and in the province of Oran they reach their highest development, and are rich in fossil echini.

The area occupied by the pliocene is much more limited, and is composed of some isolated lacustrine deposits in the province of Constantine, with perhaps certain belts in the Saharian region, and of small enclosed patches of marine origin filling depressions near the coast. The quaternary covers enormous areas, and belongs to different epochs. The strata are terraced in the valleys hollowed out during the quaternary period, or fill the great depressions of the high plateaux and of the Sahara. These are of lacustrine, fluviatile or continental origin, but marine beds occur in many spots along the coast from Tripoli to Morocco. The great superficial development of these beds in the plateaux and the Sahara, and the thickness they attain in the depressions, cause some to refer them to the upper tertiary, and some to believe them to be the work of a gradually drying-up interior sea. Several of the characteristic mammals have been found, but it cannot be said that these beds have been thoroughly explored.

THE CARBONIFEROUS FLORA OF RHODE ISLAND.—The following is a list, with descriptions of two new species, of such of the fossil Carboniferous plants of Rhode Island as are contained in the Museum of Brown University, Providence, R. I., and which have been sent me for identification, and of those which I have had opportunities to see in different collections, especially that of the Museum of Comp. Zoöl. of Cambridge, and of Mr. R. D. Lacoe of Pittston. Those from Valley Falls, R. I., have in part been collected by Mr. Thomas Battey, and those from Rhode Island, near Portsmouth, were collected by J. H. Clarke, Esq. A few species have been collected at Cranston, R. I., by Professor A. S. Packard.

A few species from the Rhode Island coal series were enumerated and figured by Dr. C. T. Jackson in his Report on the Geology of Rhode Island, published in 1840. A few others have been figured by Professor Teschemacher, in Boston Journ. Soc. N. H., Vol. v, Pl. XXXIV. The others are described and mostly figured in the U. S. Coal flora, Report P, of the second Geological Survey of Pennsylvania.

The following list embraces eighty-eight species, of which fifty-six are ferns:

FILICACEÆ.

Sphenopteris fuciformis, sp. nov.—Frond polypinnate; pinnæ linear or narrowly lanceolate, bipinnatifid; pinnules alternate, oblong, pinnately divided into simple, linear, obtuse or inflated at apex, open or reflexed segments.

The whole plant apparently originally soft, is deformed by compression. The main rachis is flat, smooth, like all the parts of the plant, 2^{mm} broad; that of the lateral pinnæ is half as broad; that of the pinnules a little more than $\frac{1}{2}^{mm}$ in diameter; the laciniæ 3^{mm} long, $\frac{1}{2}^{mm}$ broad or a little more, are open and somewhat curved back, all simple and entire.

This species closely resembles *Sphenopteris laxa* St., Fl. d. Vorw. I, Pl. 31, fig. 3, described in II, p. 58; and also *S. elegans* Brgt., differing essentially in the laciniæ alternate, simple not bifid nor forked at the apex.

Sphenopteris pseudo-murrayana Lesq.—Upper part of pinna.
Sphenopteris gravenhorstii Brgt.
Sphenopteris chærophylloides Brgt.
Sphenopteris cristata St.
Sphenopteris elegans Brgt.
Sphenopteris hæninghausii Brgt.
Sphenopteris tridactyites Brgt.
Neuropteris cordata Brgt.

Neuropteris hirsuta Lesq.—With a Cyclopteris, round or reniform large leaflet, and also small round basilar ones; all detached from the rachis and representing the same species.

Neuropteris agassizii Lesq.
Neuropteris crenulata? Brgt.
Neuropteris desorii Lesq.
Neuropteris germari Goepp.
Neuropteris heterophylla Brgt.
Neuropteris tenuifolia Brgt.
Cyclopteris species.
Dictyopteris scheuchzeri Hoffm.—As figured by Roehl.

Callipteridium sp. nov.? or variety of *Alethopteris urophylla* Brgt.—Main rachis somewhat large, 3–4^{mm} in diameter; ultimate pinnæ very long, close, narrow, nearly at right angles; parallel; pinnules slightly inclined upward, or open, subopposite, separated to the base, connate at the base only, oblong-lanceolate, obtuse or blunt pointed, gradually narrowing from the base upward; middle nerve inflated in the lower part, effaced above the middle or under the apex; lateral veins oblique, somewhat curved back, forking once. The pinnæ are very long, the longest preserved is nearly 12^{mm} long, broken like all the others below the apex so that no ultimate pinnule is observable; they are comparatively narrow, 15^{mm} at base; only 5^{mm} at the point where they are broken; the veins are not very distinct, divided like those of *Alethopteris urophylla* Brgt., which the species resembles in the form of the pinnules. As the ultimate pinnule, which in the European species is very long and linear lanceolate, is not observable, the identification is not possible. The difference is marked in the narrower pinnæ, the more pointed pinnules and the coriaceous texture.

Odontopteris alpina Gein.—Large leaflets.
Odontopteris alata Lesq.
Odontopteris brardii Brgt.
Odontopteris deformata Lesq.
Odontopteris neuropteroides Newby.
Odontopteris patens Lesq.
Pecopteris polymorpha Brgt.
Pecopteris acuta Brgt.
Pecopteris abbreviata Brgt.
Pecopteris cyathea Bgt.
Pecopteris miltoni Brgt.
Pecopteris oreopteridis Schlt.
Pecopteris candolliana Brgt.
Pecopteris dentata Brgt.
Pecopteris arborescens Brgt.
Pecopteris aspidioides Brgt.
Pecopteris clarkii Lesq.
Pecopteris erosa Gutb.

Pecopteris pennæformis Brgt.
Pecopteris platyrachis Brgt.
Pecopteris quadratifolia Lesq.
Pecopteris (*Goniopteris*) *unita* Brgt.
Pecopteris (*Goniopteris*) *arguta* Brgt.
Pseudopecopteris cordato-ovata (Weiss.) Lesq.
Pseudopecopteris nervosa (Brgt.) Lesq.
Pseudopecopteris dimorpha Lesq.
Pseudopecopteris pluckneti (Brgt.) Lesq.
Pseudopecopteris anceps Lesq.
Pseudopecopteris muricata (Brgt.) Lesq.
Pseudopecopteris spinulosa Lesq.
Rhacophyllum affine Lesq.
Rhacophyllum clarkii Lesq.
Rhacophyllum filiforme Gutb.
Rhacophyllum filiciforme Gutb.
Rhacophyllum fimbriatum Lesq.
Rhacophyllum hirsutum var. *affine* Lesq.
Rhachiopteris sp.—Rachis of fern.

CALAMARIEÆ.

Calamites suckowii Brgt., var. *nodosus* St.—A fine specimen.
Calamites approximatus Schloth.—A twisted fragment.
Calamites ramosus Brgt. — Crushed branches.
Calamites cistii Brgt.
Asterophyllites sublævis Lesq
Asterophyllites equisetiformis Brgt.
Asterophyllites grandis St.
Asterophyllites rigidus Gein.
Annularia longifolia Brgt.—A large form.
Annularia calamitoides Schp.
Annularia inflata Lesq.
Annularia sphenophylloides Brgt.
Sphenophyllum oblongifolium Germ.
Sphenophyllum schlotheimii Brgt.
Sphenophyllum emarginatum Brgt.
Sphenophyllum filiculme Lesq.
Sphenophyllum longifolium Germ.

LYCOPODIACEÆ.

Lepidodendron longifolium Brgt.—Tuft of leaves.
Lepidodendron dichotomum St.—Leaves.
Lepidodendron (Bergeria) *quadratum* St
Lepidodendron aculeatum St.
Lepidophyllum lanceolatum Brgt.
Lepidophyllum fallax Lesq.
Lepidophyllum hastatum Lesq.
Lepidophyllum majus Lesq.
Lepidophyllum oblongifolium Lesq.
Lepidophyllum stantoni Lesq.
Lepidophyllum tumidum Lesq.
Stigmaria ficoides St.—Leaves obliquely crossing clay, and specimens of other leaves.

CORDAITEÆ.

Cordaites borassifolius Unger.
Cordaites diversifolius Lesq.

—*Leo Lesquereux.*

GEOLOGICAL NEWS.—*Carboniferous.*—A large and unusually complete example of Megalichthys was recently found near Leeds. The length is three feet eight and one-half inches, but about six inches of the tail is missing. The features of this fossil, Professor Miall states, confirm the opinion long ago expressed by Pander and Huxley as to the near affinity of this fish to Osteolepis and Diplopterus.

Jurassic.—Mr. J. W. Davis (*Ann. & Mag. Nat. His.*, June, 1884) describes *Lissolepis serratus*, a palæoniscid fish, found at Lyme Regis, England. The jaws are very long, the gape wide, clavicles are well-developed and the head is protected by sculptured surface-enameled plates.

Cretaceous.—M. Capellini, in a communication addressed to the Paris Academy of Sciences, shows that, in the Apennines as well as in the Pyrenees, the Inocerami, fuci, and worm tracks of the strata known as "Flysch" are identical with those of the cretaceous rocks of Liguria and Tuscany. He recommends that the term "Flysch" be dropped from geology.——Twenty-two years ago in the scaglia (cretaceous) of Verona, the remains of a great

fossil animal were found. The report spread that it was a fossil man, and the proprietor asked an enormous price for it, until he was at last convinced it was a reptile. It then fell into the hands of Dr. Capellini, who found it to be a tortoise of the Sphargis group.——M. A. Gaudry recently presented to the Paris Academy of Sciences a note upon a new sirenian found in the Paris basin, and named by him *Haliterium chongueti.* It occurs in the *Ostrea cyathula* marls, and must not be confounded with *H. schinzi.*

Trias.—At a recent meeting of the Royal Geological Society Professor Owen described *Rhytidosteus capensis*, a labyrinthodont amphibian from the Trias of the Cape of Good Hope. The specimen consisted of the anterior part of the skull with a portion of the mandible attached.

Tertiary.—E. T. Newton has recently written upon the antelope remains from the newer Pliocene beds of Britain, and has described a gazelle which, though near to *G. bennettii*, he regards as new, and entitles *G. anglica.*

Quaternary.—M. G. Rolland has presented to the Academy of Sciences of Paris a series of objections to the theory of a quaternary Saharian sea. One of these is the absence of any true bed of marine fossils in the recent strata of the Sahara, since *Cardium edule* is rather a brackish-water than a marine species. A second objection is derived from the levels. M. Rolland believes that from the commencement of the tertiary the Sahara formed a continent except in the relatively narrow space in the north-east, occupied by the eocene sea; at the end of the miocene all the north of Africa had definitely emerged, and since that epoch the contour of the southern coast of the Mediterranean has not sensibly varied. Both M. Rolland and M. Pomel consider the quaternary formation of the Sahara as continental in origin, and deposited by diluvial waters in an age when the Sahara was abundantly supplied with rivers.

MINERALOGY.[1]

NEW MINERALS.—(1). *Aimafibrite*[2] (Igelström).—Among the manganese minerals of Nordmark, Sweden, are several new species, described by Igelström and others. Aimafibrite, so called from its blood-red color and fibrous structure, is a basic hydroarseniate of protoxide of manganese with a little protoxide of iron, magnesia and lime. Its crystalline form is an orthorhombic prism, the crystals radiating from a point and forming globules. It occurs in globules about a centimeter in diameter, which are made up of radiating fibers. It is soluble in acid, gives water in

[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] Bull. Soc. Min. de France, VII, 1884, p. 121.

the tube, fumes of arsenic on charcoal, readily melts without decrepitation and gives decided reactions for manganese.

Analysis gives:

As_2O_5	MnO	FeO	MgO	CaO	H_2O	
29.94	46.98	4.65	2.00	1.50	14 93	= 100

Formula: $2(3MnO\ As_2O_5) + 7MnO\ HO + 6HO$

(2) *Aimatolite*[1] (Igelström).—At the same locality, associated with the last, is a blood-red transparent mineral having the appearance of precious garnet. It occurs always in crystals and is imbedded in limestone. The crystals are from one to two millimeters in diameter, and according to an investigation by Bertrand, occur in rhombohedrons, and have a perfect basal cleavage. It has the same blowpipe characters as aimafibrite.

Composition:

As_2O_5	MnO	FeO	MgO	CaO	H_2O	
25.70	34 55	13.05	8.10	2.52	16.08	= 100

Formula: $2(3MnO\ As_2O_5) + 8MnO\ HO + 6HO$

(3) *Allaktite*[2] (Sjögren).—This is another arseniate of manganese from the same locality. It is of yellow to green color and occurs in flat tabular crystals, belonging to the monoclinic system. Crystallographically it is regarded as related to the vivianite group of minerals. It has a hardness of 4 to 5, and spec. grav. 3.83–3.85.

Composition:

As_2O_5	MnO	FeO MgO CaO	H_2O	
28.57	61.92	1.15	9.01	= 100.65

Formula: $2(3MnO\ As_2O_5) + 8MnO\ HO + HO$

For comparison with the three formulæ here given that of a fourth hydro-arseniate of manganese from the same locality is added. The formula of chrondroarsenite is $2(5MnO\ As_2O_5) + 5HO$. Of these four minerals the least basic is chrondroarsenite, and the most basic, aimalolite.

(4) *Bröggerite*[3] (Blomstrand).—This mineral is yet another from the same prolific locality. It is an uranium mineral allied to uraninite. It occurs in black crysta's of the isometric system and in crystalline masses. The octahedron is the common form. Hardness 5–6; specific gravity 8.73.

Composition:

UO_3	UO_2	PbO	ThO_2	Ce_2O_3	Y_2O_3	FeO	CaO	SiO_2	H_2O	
38.82	41.25	8.41	5.64	0.35	2.42	1.26	0.30	0.81	0.83	= 110.12

(5) *Colemanite*[4] (Evans).—J. T. Evans has given this name

[1] Bull. Soc. Min. de France, VII, 1884, p. 121.

[2] Geol. För. Förh. Stockholm, VII, 1884, p. 109.

[3] Geol. För. Förh. Stockholm, VII, 1884, p. 59.

[4] Bull. Calif. Acad. Sciences, No. 1, p. 57.

(called after W. T. Coleman) to a hydrous borate of calcium from Southern California. It is described as possessing monoclinic crystallization; $I \wedge I = 108\frac{1}{4}°$. Luster vitreous to adamantine, often splendent. Cleavage clinodiagonal, perfect, affording readily thin, smooth and polished laminæ. Hardness 3.5 in the amorphous to 4.25 in the crystalline variety. Specific gravity 2.428. Colorless, transparent, sub-translucent to milky. Rather brittle. It decrepitates violently and then sinters in the blowpipe flame. Readily soluble in acid, giving abundant flakes of boracic acid. Admixtures of soda were found even in the clearest crystals.

Disregarding the soda the composition is:

B_2O_3	CaO	H_2O		
[50.98]	27.18	21.84	=	100

The formula $2CaO\ 3B_2O_3 + 5H_2O$ is deduced.

It is closely allied to priceite and is perhaps identical with it. Analysis of the massive mineral are stated to give results closely agreeing with the formula of priceite.

(6) *Manganostibite*[1] (Igelström).—This mineral occurs at Nordmark, Sweden, with other manganese minerals in primitive limestone (Laurentian). It occurs in small black grains, resembling magnetite or hausmannite. It is compact with difficult cleavage and with greasy luster. It is supposed to be orthorhombic. Before the blowpipe it is infusible, and with carbonate of soda gives fumes of arsenic and antimony. Reactions for manganese are readily obtained. It is perfectly soluble in chlorhydric acid, but in nitric acid gives insoluble oxide of antimony.

Composition:

Sb_2O_5	As_2O_5	MnO	FeO	CaO	MgO		
24.09	7.44	55.77	5.00	4.62	3.00	=	99.92

Formula: $5MnO\ (Sb\ As)_2\ O_5$

(7) *Salmite*[2] (Prost). — This is described as a manganesian variety of chloritoid, occurring in irregular masses at Vielsalm, Belgium. Color gray; hardness 5–6; specific gravity 3.38.

Composition:

Si_2O	Al_2O_3	Fe_2O_3	FeO	MnO	CoO	MgO	CaO	H_2O	Quartz		
19.14	33.66	3.38	13.05	7.14	0.04	1.79	0.30	6.32	15.06	=	99.88

(8) *Utahite*[3] (Damour).— Damour has proposed this name for a hydrous basic sulphate of peroxide of iron, which occurs in minute hexagonal crystals of micaceous structure in the mines of Eureka Hill, Juab county, Utah. The specimens were taken to France by Ochsenius, and first described by Arzuni, but named by Damour. The crystals of this mineral are of a yellowish-brown color and so small as hardly to be visible to

[1] Bull. Soc. Min. de France, VII, 1884, p. 120.

[2] Geolog. Soc. Belge.

[3] Bull. Soc. Min. de France, VII, 1884, p. 126.

the naked eye. They form a crust on compact quartzite. They occur in regular hexagonal prisms and have a micaceous basal cleavage. They are optically uniaxial, and belong, therefore, to the hexagonal system.

Heated in a matrass, acid water is disengaged, and the mineral becomes red. In the blowpipe flame it fuses to a black scoria. It is attacked by chlorhydric acid heated to the boiling point, but not by nitric acid.

Analysis gave (Damour):

SO_3	AsO_5	Fe_2O_3	H_2O
28.45	3.19	58.82	9.32

Formula: $3Fe_2O_3\ 3SO_3 + 4H_2O$

FLEXIBLE SANDSTONE.—In a note in the June NATURALIST on flexible sandstone from Pennsylvania, its flexibility was regarded as due to its decomposition. As regards the itacolumite of Brazil, Mr. J. C. Branner, formerly of the Geological Survey of Brazil, writes to us as follows:

"I once spent a year in the diamond region of Minas Geraes, Brazil, where I had the best of opportunities for observing the itacolumite, which is there the country rock. In one place a canal several miles in length was being cut by a mining company, and in many places through this flexible sandstone. Owing to its flexibility it was very difficult to blast, for instead of breaking out in large fragments, the rock would often yield and bend like so much leather, and only a few fragments would be broken off about the mouth of the hole. On account of this difficulty in blasting, it was frequently necessary to cut it out with the pick. In one place the rock was cut through to a depth of about twenty-five feet from the surface, and yet at the bottom of this cut the decomposition and flexibility was almost as marked as near the surface. But in the deep gold mines in the itacolumite this flexibility was never found very far beneath the surface. I regret to say that I made no exact measurement of the depths at which it ceases. I may say, however, that at a distance of about a hundred feet from the surface this sandstone was no longer yellowish or light brown, but was of a somewhat leaden color, and that its characteristic flexibility had disappeared entirely.

"Again at a certain stage of decomposition more advanced than that indicated by flexibility, this sandstone simply fell apart when broken in the hand, or could be cut through more easily than ordinary earth. It would be interesting to study the depth of decomposition of itacolumite by noting the depth at which it ceases to be flexible."

MINERALOGICAL NOTES.—A union has been effected between the Mineralogical Society and the Crystallogical Society of Great Britain. The Crystallogical Society brings with it several mineralogists of high attainments, who will be likely to make the

Mineralogical Magazine a more valuable journal than it has been heretofore. Several of the articles in that journal have been more notable for quantity than quality. Like the other English societies the Mineralogical Society has gravitated to London, although originally intended as a peripatetic society.——Native lead has been observed in cavities in red carbonate of lead from Maulmain, Burma, India. It occurs in small masses associated with minute crystals of white cerussite. The bright red color of the cerussite containing the native lead is probably due to an intimate mixture of minium.——H. A. Miers, of the British Museum, has measured with a Fuess goniometer several crystals of the rare mineral *meneghinite*. It occurs in slender needles, and the end planes are very small. The needles are deeply striated or channeled, making measurements difficult. A number of new faces were observed, and the crystals determined to be *orthorhombic*, with the axial lengths a : b : c = 1.89046 : 1 . .68664.——Associated with galena, and filling cavities in quartz, an interesting form of *kaolinite* occurs in Ouray county, Colorado. The mineral appears as a mass of glistening white scales visible to the naked eye, and under the microscope show as perfect transparent crystals having well-defined pyramidal planes. —— Dr. M. E. Wadsworth has issued a descriptive catalogue of one hundred thin sections of American and foreign rocks for the use of students of microscopical lithology. The collection consists of European rocks described by Rosenbusch, Zirkel and several other European lithologists, together with a number of American rocks described by Dr. Wadsworth. This appears to be the most complete and systematic collection for students that has yet been arranged.

BOTANY.[1]

The Fertilization of Giant Hyssop (Lophanthus nepetoides).—The giant hyssop has greenish-yellow flowers about one centimeter long. The inner stamens are the longest and are the first to appear on the opening of the bud (Fig. 1). While the outer or shorter pair of anthers develop and take a position

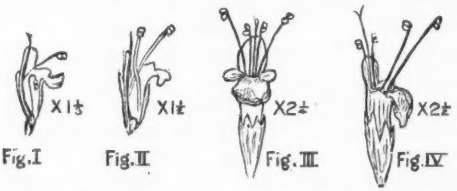


Fig. 1.—Section of opening flower. Fig. 2.—Section of open flower. Fig. 3.—The same, front view. Fig. 4.—Side view of flower with the stigma-lobes mature.

close to the upper lip, the inner or longer stamens move forwards so that the filaments of the two sets cross each other (Fig. 2). The inner stamens therefore are near the lower lip of the corolla

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

and diverge considerably, while the outer pair stand erect and close together near the upper lip (Fig. 3). During this time the stigma lobes are closed and the style has grown to the length of the longest stamens and assumed a position almost erect, inclined rather to the back of the flower (Fig. 4). The flowers are therefore proterandrous, but not purely so. In the bud all the stamens and the style curve forwards under the lower lip.

The distinguishing feature between this and the ordinary Labiatæ consists in the crossing of the filaments, by means of which the longer inner stamens take the appearance of being the outer stamens, and in the curvature of the style. The style of the Labiatæ usually bends forwards at maturity, so as to meet the body of the visiting insects. In this species it seems to bend backwards, often much more than represented in Fig. 4. In truth, however, this bending occurs before maturity, and either remains so at the time the stigma matures, or the curvature forwards is rather slight, leaving it behind a line vertical to the individual flowers.

The visiting insect begins at the lower part of the interrupted spikes, receiving pollen on its sides from the longer stamens, and under its body as it crawls over the smaller ones to the next flower, at the same time leaving pollen on the stigma lobes. The flower has accommodated itself to the crawling habit of its visitor.

To explain more fully, the flowers of most Labiatæ are so arranged as to necessitate the entrance of the insect from one particular position, compelling them generally to leave the plant each time and thus fly to the individual blossoms it chooses to visit. Hence the curvature of the style forwards is adapted to touch the insect in one particular spot each time. In the case of Lophanthus the flowers generally are blossoming throughout the whole length of the spike at the same time, and from the shortness of the tube and lips of the flowers the bees readily crawl from one flower to the next in a rather indefinite fashion. The backward curvature is here the best adapted to the circumstances since it does not offer any unnecessary resistance to the body of the insect. Still the arrangement of the flower must be considered as of a low degree of specialization.—*Aug. F. Foerste, Granville, Ohio.*

The Injuriousness of Porcupine Grass.—Our inquiry as to whether porcupine grass has ever been known to injure domestic animals in this country is answered as follows by Dr. M. Stalker, the State veterinarian of Iowa:

You ask whether the fruits of porcupine grass (*Stipa spartea*) are ever a source of inconvenience or injury to living animals? This may be very emphatically answered in the affirmative. In many of the north-western counties of Iowa this grass grows in

the greatest profusion, and during the latter part of June, the season for maturing and consequent falling of these spines. they are the occasion of much annoyance and in some instances the death of domestic animals. Only such animals as are covered with wool or a thick growth of long hair are seriously inconvenienced. Sheep suffer most. The spines readily find a lodgment in the wool, and after burrowing through it frequently penetrate the skin and bury themselves in the flesh. A large number of these barbs thus entering the tissues of the body produce an amount of irritation that is sometimes followed by death. I have seen large numbers of these imbedded in the skin and muscular tissues of shepherd dogs that were covered by a thick growth of soft hair. These sagacious animals frequently exhibit the greatest dread at being sent into the grass during the season of danger."

STRUCTURE OF THE FRUIT OF PORCUPINE GRASS.—The mature "fruit" of this interesting grass consists of a narrow cylindrical grain (Fig. 3) about 1^{cm} long and 1^{mm} thick. This is enclosed in

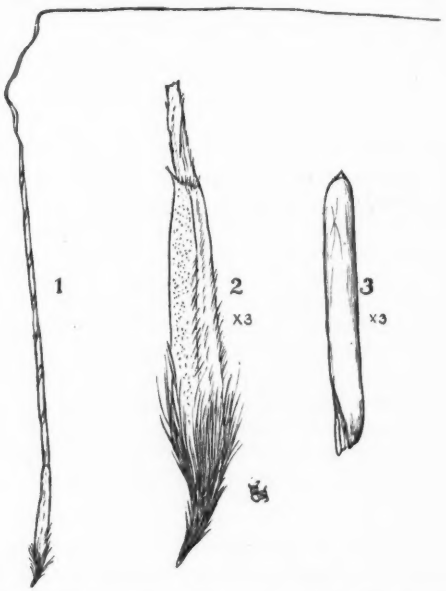


FIG. 1.—Entire "fruit" of porcupine grass, natural size, showing the twisted awn. FIG. 2.—Lower portion of the same, enlarged. FIG. 3.—Grain of same, enlarged.

the two hard persistent palets, the larger of which bears a tough awn from 12 to 16^{cm} long (Fig. 1). This larger palet completely encloses the smaller one, and at maturity it is quite difficult, with

the naked eye, to make out its overlapping margins. Its lower portion is densely covered with stiff hairs (Fig. 2), as is also the short pedicel upon which the whole flower rests. This pedicel is tapering, curved and greatly indurated, and at the maturity of the fruit it separates at its lower end from the rest of the axis. At its point of separation, which now becomes the lower end of the "fruit," it is very sharp, readily piercing clothing or even the skin of the back of one's hand. The hairs prevent the withdrawal of the point, and tend to cause it to enter more deeply.

The awn, which is at first straight, is channeled on two nearly opposite sides. Both the channels, as well as the general surface of the awn, are provided with short stiff hairs which act as barbs. At maturity the awns begin twisting throughout a little more than their lower half as shown in Fig. 1, but the upper portion remains straight or nearly so, and soon becomes bent at nearly a right angle to the twisted part. This twisting facilitates the entrance of the barbed pedicel and palets into the soil, and, as lately pointed out, into the skins of sheep, dogs and other domestic animals. The greater weight of the lower end of the whole "fruit" makes it, before the twisting of the awn, an excellent dart, and on falling out of the glumes it invariably strikes point downwards.—*C. E. Bessey.*

An abnormal Fuchsia blossom.—I have lately had an opportunity of examining an abnormality of the calyx of a fuchsia, which seems to allow of certain important deductions.

It consists of the partial modification of one of the sepals into a foliage-leaf. A distinct midrib extends up the center of the sepal, which, on one side, is of the color and structure usual in the sepals of the fuchsia, while the other half is exactly similar to the half of a foliage-leaf of the same plant, presenting a green color, the toothed margin and the ordinary venation, being also the same width as half a foliage-leaf, and thus much broader than the portion on the other side of the midrib. Accompanying this modification there is a partial separation of the sepal from the calyx-tube. The unmodified half is adherent to the adjacent sepal, the leaf half only being separated and modified so as to represent below a leaf-petiole. This separation extends down to the base of the calyx-tube, and even to the base of the green receptacle below this.

Abnormalities similar to this seem to be of not uncommon occurrence. Among others Arndt (Botan. Jahresb., 1878) describes a case in which the limbs of the calyx were some half, others altogether green, the margins being toothed; Liebe (Botan. Jahresb., 1880) one in which the sepals were transformed into long-petioled foliage-leaves; and Buchenan (Botan. Jahresb., 1880) besides stating a case that came under his own observation, in which two of the sepals had become transformed into foliage-

leaves, springing apparently from the base of the receptacle, and having in their axils each a stamen, cites a case observed by Suringar in which one sepal with the two stamens opposite it became separated from the flower in a similar manner, and also one observed by Magnus in which all the sepals were transformed into foliage-leaves and separated as far down as the base of the receptacle, similar, accordingly, to the condition observed by Liebe.

Besides supporting the now universally accepted theory of the foliar nature of the sepals, the above instances and the one I have observed strengthen a supposition made by Magnus (Botan. Jahresb., 1879) after a study of two monstrous orchids, that in this order, as well as in the fuchsia, the green enlargement found below the floral leaves is not formed by the hollowing out of the axis, nor yet of carpellary leaves enclosed by an enlargement of the axis, but is an organ of a foliar nature. In other words, in the case of the fuchsia the dilatation is formed by the union of the bases of the petioles of the calycine leaves with each other and with the ovary, and therefore consists of two portions—in the interior the ovary and on the exterior the coalesced petioles. The term *receptacle* applied to it above is accordingly not correct, but was employed for convenience.

Another point indicated is, that the calyx-tube is *not* formed by the coalescence of those parts of the sepals which correspond to the petioles of foliage-leaves, the limbs representing the lamina, but consists partly of both petioles and laminæ. This was very evident in the case I examined, where the abnormal part was half sepal and half foliage-leaf, and therefore permitted a direct comparison. How far this may hold good in other cases in which the calyx (or even the corolla, as in the Primulaceæ and Caryophyllaceæ, for instance) is composed of a well marked tube and limbs, or parts corresponding to them, I have not had opportunity to determine.—*J. Playfair McMurrich, Guelph, Canada.*

Botanical Notes.—The June *Torrey Bulletin* contains, among other articles of interest, one on the may-apple, by Aug. F. Foerste, devoted mainly to structure and development. Some odd abnormalities are figured. Many of these, however, were figured and described by Professor T. C. Porter in the *Botanical Gazette*, in 1877 (Vol. II, No. 9). In this connection we may record the fact, that in Central Iowa this year many colonies of may-apples were found with distinctly *pink* flowers.——The Table Alphabetique of Henri Van Heurck's Synopsis des Diatomées de Belgique has just been received by American subscribers.—— Fascicles I and II of Luerssen's "Farnpflanzen oder Gefassbündelkryptogamen" (being parts of the third volume of the new edition of Rabenhorst's Kryptogamen-Flora) has lately appeared. It promises to be a work of great interest to pteridologists.——

Oberlin College is fortunate in coming into the possession of the extensive collection of plants made by Dr. Beardslee, of Painesville, Ohio.——In an important paper read before the American Philosophical Society, Oct., 1883, and printed May 12, 1884, John C. Branner discusses the course and growth of the fibro-vascular bundles in palms. He reviews at length the various theories which have been held as to the course of the bundles in the palms, a subject well known to be surrounded by many difficulties. The discussion is based upon direct personal observations and study of a large number of specimens of no less than seventeen different genera.——The long looked-for Manual of Mosses, by Lesquereux and James, has at last been issued by Cassino & Co., of Boston. An adequate notice will appear soon. ——Wm. Boott describes several new sedges in the June *Bot. Gazette*.——In the same number the announcement appears that Professors Coulter and Barnes are engaged in a special study of the North American species of the genus Cyperus, and desire to receive specimens. "Loaned specimens will be retained for as short a time as possible, and carefully returned."——The "Questions on botany," prepared by Professor Spalding for the use of students who have attended the general lectures on botany delivered in the departments of pharmacy and medicine in the University of Michigan, indicate that in another of our medical schools the importance of biological botany is fully realized——Mr. R. M. Christy read a paper recently before the Linnean Society of London on the power of penetrating the skins of animals possessed by the seed of *Stipa spartea*. "Inquiry among butchers and others showed conclusively that large numbers [of these seeds] were often found beneath the skin of sheep, especially about the shoulders." This grass is abundant in the Mississippi valley (where it is known as Porcupine grass), and we have been familiar with it for years, but have never before heard of its penetrating the skins of animals. Has this been noticed by NATURALIST readers?

ENTOMOLOGY.

LIFE-HISTORIES OF SOME GEOMETRID MOTHS.—These and other unpublished notes on Lepidopterous larvæ have been prepared in connection with work on our forest trees done for the Entomological division of the U. S. Department of Agriculture, and to be incorporated in the fifth report of the U. S. Entomological Commission.

Aplodes coniferaria, n. sp.—We have reared six moths from curious 14-flapped larvæ found feeding in August on the fir and hemlock, and described in Bulletin VII, U. S. Ent. Comm., p. 238, and referred by us to Aplodes. The caterpillar is dull brick-red, with seven pairs of broad dorsally situated flat flaps on each side. It bears a striking resemblance to the small reddish twigs of the fir with the leaf scars.

From the 4th to the middle of September the caterpillars made, between the twigs, a loose, slight, open cocoon of bits of small twigs and leaves, held together by silk, within which the pupa rested through the winter.

The pupa is of the usual form, rather slender, brown, the abdomen bright brick-red above between the wing-covers; the end horn-brown and mottled; there is a blackish dorsal line and a dark stripe along the antennæ and veins of the wing, the branches being spotted with black. In another specimen the wing-covers were red and the body, including abdomen, horn-colored; the terminal spine is short, moderately stout, with eight unequal curved slender spinules. Length 9–10$^{mm.}$

Walsh's description of the larva of *Aplodes mimosaria*, which he bred from the oak, is too brief for comparison, but our specimens do not disagree with his diagnosis, though we have never found it on the oak, but frequently on the coniferous trees mentioned.

Six specimens, two of them males, issued from the chrysalids in the breeding box, in Providence, between April 20th and 25th. They were all of uniform size, the wings expanding about 25$^{mm.}$ They differed but slightly from *A. mimosaria* though much smaller; compared with one of the latter the hind wings are more angulated, while the outer white line on the same wings is less bent in the middle. The lines on the fore wings are as in *A. mimosaria*, but vary in distance apart. The head and abdomen are marked as in *A. mimosaria;* the male hind tibiæ are as in that species. It differs decidedly from the two other species of its size, *A. approximaria* and *latiaria.*

On sending specimens to Mr. J. A. Lintner, to compare with his types of the species in his possession, he kindly writes as follows:

"Differs from *mimosaria* in the outer line of front wings being nearer to the margin, and the inner line being angulated on the submedian instead of curved. The outer line of secondaries is nearer to the margin than in *mimosaria*, and is more regular.

"It approaches nearer to *latiaria*, but the two lines are more approximate, and the inner line is more angulated on the submedian. It also has an inner line on the secondaries which *latiaria* has not."

Endropia textrinaria.—The caterpillar was found on the white oak at Providence, Oct. 7th. The body is rather slender, the head wider than the segment behind, rounded, rather deeply bilobed, swollen on each side of the apex of the clypeus; the latter edged with dark brown, forming a V-shaped line on the front of the head. The prothoracic segment is normal, while the mesothoracic segment is much swollen on each side, the rounded swellings connected by a dorsal curved ridge. On the metathoracic segment is a small transverse ridge, next to that on the meso-seg-

ment. On the hinder part of the 3d abdominal segment is a large double dorsal dark knob-like hump. On the 6th is a conspicuous dark transverse rounded ridge, enlarged and higher at each end. The 8th segment has large warts, and there are also large warts on the sides of segments 7–10. The supra-anal plate is triangular but short, with four hair-bearing warts above and four at the end. Anal legs large and broad. The short penultimate segment has a transverse row of eight large warts; these warts are obsolete on the front half of the body.

The body is of exactly the color of an oak twig, being dark gray shaded with light, and of the same color beneath as above; while the knotted appearance of the segments behind the head and in the middle of the body assist in the deception, the caterpillar being remarkably like a bit of oak twig. The anal conical dorsal tubercles are large and distinct.

Oct. 10 it began to spin a thin slight web at the bottom of the breeding box, and the pupa appeared Oct. 12.

The pupa is 15^{mm} in length, light horn-brown, the wing-covers dull brick-red; antennæ and limbs striped with black. The spiracles are prominent and black. The terminal spine ends in two long slender straight sharp acute spinules.

The moth appeared in the breeding box in May.

Paraphia deplanaria.—The caterpillar of this moth was found at Brunswick, Me., June 23d, on the fir. The body is cylindrical with no tubercles, and in color and appearance like a bit of a fir twig. Head rounded, somewhat bilobed, greenish, mottled and finely spotted, especially on the vertex on each side, with reddish-brown. Body reddish-brown, washed with greenish, and with a row of lateral irregular dark blotches. Length 22^{mm}.

The pupa was found June 28, and is of the usual dark tan-brown color, rather stout; the moth appears about July 8–10.

Tetracis lorata.—The moth was bred from a large twig-like caterpillar found on the hemlock at Brunswick, Maine, Aug. 25. Head flattened, square in front but not notched, slightly full on each side of a slight median impressed line. Pale gray, with a diffuse straight vertical band on each side, the middle being clear whitish gray. These dark latero-frontal bands and the pale gray median band are continued on to the prothoracic segment. The median whitish band is continued on to the meso-thoracic segment, but forms there two linear parallel white thread-like lines enclosing a linear brown median line; on each side of this ring, directly behind the prothoracic spiracle, is a large rough tubercle; the granulations coarse and prominent; white on the sides, above tawny-brown. On the 1st and 2d abdominal segments is a pair of swollen infra-spiracular rounded tubercles, concolorous with the body. The body is dull reddish-brown. The two piliferous warts are connected and converted into a transverse tubercle, becoming larger towards the 5th abdominal segment; the

tubercles behind rather large but not connected. From the 5th abdominal segment to the end of the supra-anal plate extends a black median line. Along the sides of the abdomen, on segments 2–5, is a lateral raised short brown line edged below with pale gray; these are situated in front of the spiracles. Below are three large tubercles on each segment, and there is a tubercle beneath. Hence the caterpillar represents a large rough twig, with leaf-scar-like tubercles. Anal plate sharp, triangular, tuberculated. Anal legs large. Length 38$^{mm.}$

The pupa is rather thick; the body in front, including the wings, horn-brown, speckled with blackish; abdomen reddish-brown. Spiracles distinct black. Terminal spine large, ending in two long straight acute spinules. Length 17$^{mm.}$

The moth appeared in the breeding box April 25. *Tetracis crocallata* feeds on the sumac, according to Mr. Saunders.

Metanema quercivoraria.—This was raised from the oak, but the larva unfortunately not described. The pupa is rather slender, reddish horn-brown; spine acute, large and flat. Length 13$^{mm.}$ The moth issued May 3. Several were taken at Keene Flats, Adirondacks, June 12, in a locality where no oak trees were seen.—*A. S. Packard.*

Bombus plundering different species of Plants.—On page 20 of Mr. Ogle's translation of Dr. Kerner's interesting treatise on "Flowers and their unbidden Guests," the author, after discussing the fertilization of the European species of Pedicularis by *Bombus montanus*, says: "It appears that the humble bees always devote themselves at one time to the plunder of one species of plants," to which the translator adds: "It is curious that a similar observation as to the habits of bees should have been made by Aristotle, 'a bee,' he says (H. An., IX, 40), 'on any one expedition does not pass from one kind of plant to another, but confines itself to a single species, for instance, to violets, and does not change until it has first returned to the hive.'"

In the light of the above, a few observations I have recently made on the subject may be of interest. In five instances I saw a large species of Bombus fly from the flowers of the common lousewort (*Pedicularis canadensis*) to those of the vetch (*Vicia americana*) and *vice versa*. In another instance a Bombus went from a blue hyacinth (*Hyacinthus orientalis*) to a columbine. Another went from the flowers of a small Solomon's seal (*Polygonatum biflorum*) to dandelion. Another was working on vetch, from which it flew to the flowers of a trumpet honeysuckle (Lonicera), thus visiting in succession flowers belonging to three different families, and of three different colors.—*Clarence M. Weed, Mich. Agri. College.*

Examining the Heads of Insects, Spiders, &c., alive.—Mr. E. T. Draper recommends a cone of pasted paper to be made

rather larger than the specimen, with the apex cut off. A vigorous spider will soon project its head through the aperture; when in this position it should be blocked behind with cotton or wool slightly wetted. The cone can then be gummed to a slip, apex upwards.

Many insects can be arranged in the same way for the observation of facial movements, and such front views admit of interesting and extended study; the action of the antennæ, palpi and various organs of the mouth may be watched and curious effects produced by the excitation of saccharine or nitrogenous juices, administered from the tip of a sable pencil.—*Journ. of the Royal Micros. Soc., April, 1884.*

Anatomy and Function of the Bee's Tongue.—In a paper read before the Linnean Society of London, Mr. F. J. Briant remarked that authorities are yet divided in opinion as to how the organ in question acts. Kirby and Spence, Newport and Huxley aver that the bee laps its food; while Hermann Müller and others attribute a full share to the terminal whorl of hairs to which the honey adheres, and therefrom is withdrawn. Mr. Briant, on the other hand, from experiment and study of the structures, is inclined to the view that the honey is drawn into the mouth through the inside of the tongue by means of a complicated pumping action of the organ, aided by the closely contiguous parts.

We might add that Réaumur states that the bee does not suck up the liquid sweets but laps them up with its long slender hairy tongue. A better view than Mr. Briant's is, it seems to us, that of Shuckard, quoted in our "Guide to the Study of Insects."

Entomological Notes.—The number last issued of the Transactions of the American Entomological Society, the first of Vol. xi, is no less valuable than its predecessors. It contains Dr. S. W. Williston's tables, or rather synopses, of two groups of the North American Asilidæ, illustrated by two plates, with an account of a new genus of Syrphidæ. Our Asilids are but little known. There are three subfamilies, the Dasypogoninæ, comprising thirty-five genera and one hundred and twenty-five species; the Laphrinæ with eleven genera and fifty species, and the Asilinæ. The latter group is little known. W. Ehlers, of Spain, describes two new blind Bembidii, one from St. Thomas, West Indies, and the other from Florida. Mr. Frank Aaron describes and figures new species of Psocidæ from near Philadelphia, among them a brown variety of *Atropos divinitaria*, and a new form, *Atropos purpurea;* also a new genus, Dorypteryx (*D. pallida*). A useful synopsis, with a plate, of the North American Apioninæ, a subfamily of weevils, is published by Mr. John B. Smith. The Cucujdæ of America north of Mexico are revised by Lieut. Thos. S. Casey, U.S.A. The article is illustrated by four plates.——Among the other good articles in the *Canadian*

Entomologist for April is one on "the survival of the fittest" among certain species of Pterostichus as deduced from their habits, in which Mr. J. Hamilton gives some facts bearing on the extinction of species of these ground-beetles in the vicinity of large cities. Of the sixteen species mentioned four must soon become extinct, and six may possibly exist in the future as rarities, four will occur not uncommonly, while two (*stygicus* and *lucublandus*) will remain as now, common.——Under the caption "La feuille qui se transforme en insecte," M. Preudhomme de Borre figures the larva of a singular mimetic form of Orthoptera (*Chæradodis rhombicollis* Latr.) from Quito, which is popularly supposed to change into a leaf.——*Zeitschrift für wissenschaftliche Zoologie*, for June 27, contains a lengthy article, with numerous illustrations, on the adhesive apparatus on the tarsal joints of insects, by G. Simmermacher, to which we shall again refer.——Mr. Hulst's monograph of the genus Catocala is apparently completed in the third number of the Bulletin of the Brooklyn Entomological Society. It contains a brief synopsis of the species, filling four closely printed pages; then follows synonyms and descriptions of the species, the latter rather too brief, but yet comparative. While the paper hardly fulfills the requirements of a monograph it is an excellent synopsis.——In his "Contributions a l'histoire des metamorphoses des Longicorns de la famille des Prionidæ," M. Aug. Lameere describes and figures the pupa of *Parandra polita* Say.——A case of development of the imago in an ichneumoned pupa is recorded in the *Entomologists' Monthly Magazine* for July, by A. F. Griffith, who, in a pupa of Tæniocampa, found that "the moth had apparently died, as so often happens, when just ready for emergence, but within the body was a parasite alive, also just ready to emerge."

ZOÖLOGY.

Structure of the Otocysts of Worms.—M. E. Jourdan's investigations were made upon the small Arenicolæ of the coast of Marseilles and in the laboratory of that place.

By sectioning the cephalic segment of an Arenicola previously fixed by the injection of a solution of osmic acid of 0.50 per cent, the auditory capsules were shown in some sections and easily recognized by their little calcareous corpuscles. The otocysts are situated in the thickness of the integuments, far from the hypodermis and in the midst of muscular bundles; they are fixed by the connective envelope of these bundles, which surrounds them. They are not in direct contact with the œsophageal commissures, but connected with them by several nerves. They are placed towards the dorsal surface.

The nerve fibers composing the commissure and the brain are very fine and striated longitudinally. Nerve-cells exist throughout the length of the commissure, some in its interior, but a much

greater number between the commissure and the hypodermis, often intimately connecting these two parts.

The otocysts are spherical. The diameter of their cavity is $\frac{11}{100}$ millim., and that of the sphere formed by the outer capsule $\frac{22}{100}$ millim. The thick walls consist of a layer of fusiform cells, a network of fibrillæ arranged in a dense plexus, and a connective envelope. The cells form the greater part of its thickness; they are very delicate, spindle-shaped, slightly inflated towards the middle, where the nucleus is situated; they also increase in thickness towards their inner extremity, where they are surmounted by a thick plate. The plates of all the cells are closely soldered together, forming a cuticle, which, in sections, is often detached from the cells which produced it. No layer of vibratile cilia was to be seen distinctly, but indications of them seemed to exist upon portions which had been long in osmic acid. The cells taper at their base and at the same time bend in different directions; and these basal prolongations anastomose and form a very delicate network of fibrillæ, which, by their union, constitute at the base of the epithelial layer a regular little zone, intermediate between the nerve-fibers and the foot of the cells; a few nuclei are distinguishable in it. This plexus rests against the connective envelope, which is formed by a thin and dense membrane, presenting perforations through which the basilar plexus enters into relations with the nerve-fibers.—*Comptes Rendus, March 24, 1884, p. 757.*

On the Pelagic Fauna of the Swiss Lakes — Dr. O. E. Imhof gives a brief summary of the investigations hitherto made in the Swiss lakes, from which it appears that up to the present time there have been found more entomostraca than true pelagic animals. He then describes the results of his own researches upon several of the lakes. He has found nine new representatives of the pelagic fauna, of microscopic dimensions it is true, but, like the crustacea, represented by a great number of individuals.

Dr. Imhof characterizes the true pelagic forms by means of the following two principal remarks:

1. The animals which are truly pelagic from their birth to their death always swim freely in the water, never going either to the shore or to the bottom of the lake, and never touching the surface of the water, so as to avoid coming directly in contact with the atmospheric air.

2. The true pelagic animals carry their ova (with the exception of the winter egg) either attached to the exterior of the body or in a sort of incubatory cavity until the young individual, whether immediately like its mother or subject to transformation, can quit the envelope of the egg or the incubatory cavity, and lead at once the mode of existence of an accomplished swimmer.

The author has studied the pelagic fauna of the following lakes:

Zurich, Zug, des Quatre, Contous, Egeri, Katzen, Greifen, Maggiore, Lugano, Como and Garda.— *Bibl. Univ., Arch. des Sci., October 15, 1883, p. 349,* and *Journ. Roy. Micr. Soc., April, 1884.*

THE "MAN-EATER SHARK," *Carcharodon carcharias* (Fig. 1 and Plate XXXI).—The various descriptions given of this species are so very imperfect and confusing that it is safe to say, with Professor D. S. Jordan in a recent letter to me, "There is no good description of the animal extant. The earlier writers spoke of it without knowing it, and all had more or less confusion between it and *C. lamna.*"

This shark was taken by me on the fourth day of August, 1883, about two miles off Great Point lighthouse, Nantucket, Mass.

The experienced fishermen of Nantucket, with all their oppor-

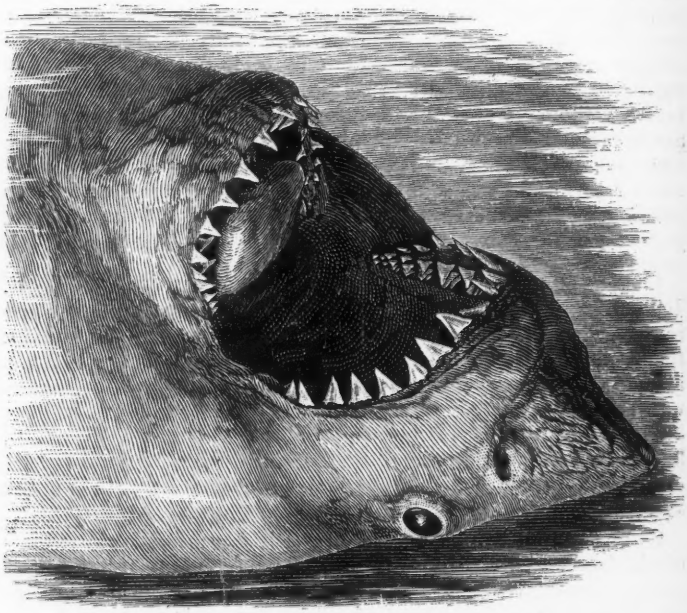


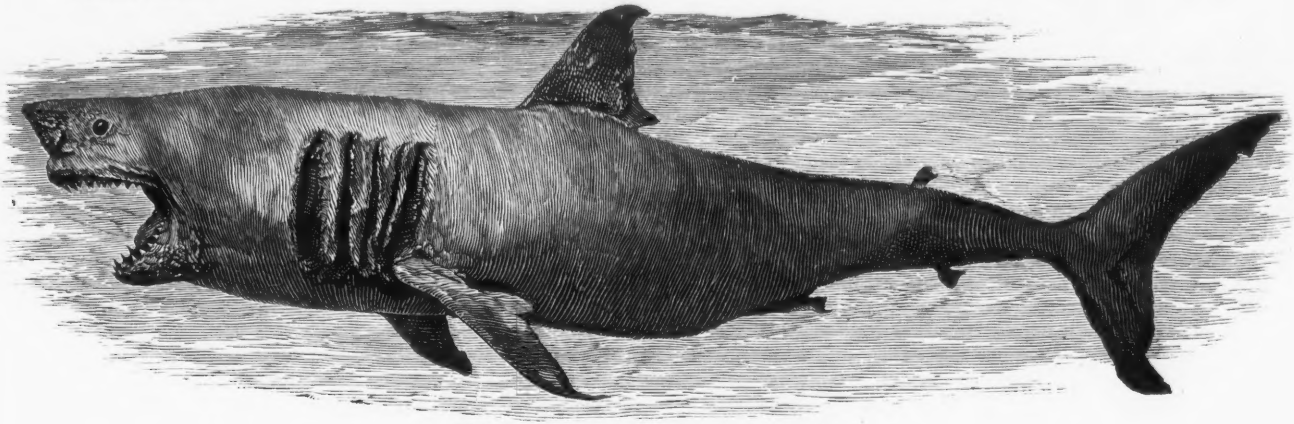
FIG. 1.—The Man-eater Shark; position of attack.

tunities for investigating this interesting family of fishes, were ignorant of the correct name of this specimen, and they regarded it as a rare species in the waters of that vicinity. It therefore became to me an object of special interest and study.

The specimen which gives me the data for this note, I have placed in the museum of Vassar Brothers' Institute in this city.[1]

[1] A full description appears in the Proceedings of the American Philosophical Society of July 18, 1884.

PLATE XXXI.



The Man-eater Shark. From a photograph.

The accompanying cuts are taken from photographs. — *W. D. Stevenson, M.D., Poughkeepsie, N. Y.*

Water-pores of the Lamellibranch Foot.—H. Griesbach has maintained the existence of *pori aquiferi* in the lamellibranch foot, while J. Carrière held the contrary view. J. T. Cattie has studied a considerable number of species, and does not find the least trace of aquiferous pores; and F. Barrois arrives at the same results. He discusses the work of Carrière and himself, and finds that they have studied most of the forms where the presence of aquiferous pores has been claimed, and in every case finds pores absent, or in such position that it seems they are either connected with the functional byssogenous organ, or, where such is absent in the adult, with the remnant of the same. Barrois sums up his views thus: "No pores exist for the introduction of water into the circulation; the only pores of the foot are those connected with the byssus organ, which never communicates with the interior of the foot. The blood may have water introduced into it, but this may be effected by osmosis, or in some manner not discussed."— *Journal Royal Microscopical Society, April.*

Two Species of Manatee in Brazil.—The mammals collected by Natterer, the Brazilian traveler and naturalist, are being worked out by A. von Pelzeln, two parts of his memoir having, according to a notice in *Nature*, appeared of the Sirenia. Natterer met with a manatee high up the stream of the Amazons, in the Rio Negro, Rio Brancho, and Madeira, and maintains in his notes that the species which inhabits these far inland waters is quite different from the *Manatus americanus* of the South American coast. Natterer called it *Manatus inunguis*, from its nailless fingers, and sent home to the Imperial Cabinet of Vienna three complete specimens and several skulls of the animal. Natterer also met with two species of dolphin in the Amazons and its tributaries.

Abnormal Food of Cats.—Strange as it may seem, little has been published upon the abnormal appetites acquired by many of our domestic animals. A moment's thought shows that all the cooked food and the milk which cats obtain in considerable quantity in a tamed state could never have formed any part of the food of their wild ancestors, while fresh fish, the food which few cats can resist the temptation of stealing, would be eaten but rarely by cats which were obliged to capture the fish for themselves, although I have seen a manx (or so-called tailless) cat bring home fishes, even eels, which she had the courage to capture in shallow pools of the tail-race of a saw-mill when the mill was stopped.

From the natural food of cats, the flesh of vertebrates, one might readily expect them to catch and eat insects. Adolph Müller mentions[1] that his cat regularly hunted at twilight the

[1] Zool. garten, Aug., 1880, jahrg. 21, pp. 253–54.

moths, chiefly Noctuidæ, in his garden. About 1870 I had a cat that, nearly every hot afternoon in summer and autumn, caught grasshoppers (Caloptenus and Oedipoda), and brought me her insect captures alive before eating them, with as much pride as if she had taken mice or birds. During the past summer I noticed several cats capture and eat beetles of the genera Lachnosterna and Prionus; the odor of the beetles of the latter genus seems sufficiently pungent and repulsive to drive away cats, since they dislike most pungent odors, but I have seen two cats that apparently regarded Prionus a delicacy, for they would eat dead, mutilated, sometimes half-decayed beetles of this genus, which they found about the yard.

Tempted by the butter or other kinds of fat upon mashed potatoes, or by the meat mixed with the potatoes in certain sorts of hash, the domestic cat has learned to eat potatoes, but most cats dislike them; cats have been in similar ways forced into accepting bread, but it still remains true that the majority of well-fed cats will reject bread unless buttered or soaked in milk. Still the cat likes a few peculiar flavors; their extreme passion for catnip (*Nepeta cataria*), and their fondness for valerian (Valeriana), have been long since observed and noted. Kleberg says[1] that the cat likes golden bread, *i. e.*, a bread flavored with saffron and spices; that it likes ginger-bread, rose-water rolls, and raisins. I have seen several cats that ate raisins, and one cat that would eat raisins, peanut-candy, lumps of sugar, figs, and nearly all kinds of nuts, but this cat was an especial pet and tasted of almost everything which its mistress ate, eating some of her food when the flavor did not prove too disagreeable.

Last summer I was greatly surprised, however, knowing the antipathy which cats generally have to amylaceous food, to find that my cat often would eat cooked green corn in preference to beefsteak. When especially anxious for corn he eats not only the corn from the cob, but the softer portions of the cob itself, although he likes best to have the corn cut from the cob for him. The idea naturally suggested itself at first that the butter on the corn led him to eat it, but he eats it greedily without butter, and often has made a hearty dinner of from one-half to a whole ear of corn, while meat remained on his plate untouched. Raw corn is not very acceptable to him, although sometimes eaten; for this farmers should be thankful, since if the feline appetite for raw corn was as good as it is for cooked corn the cats might attack cornfields, eat the corn from the ears, and thus become a serious foe to agriculture.

The belief that corn-eating was an individual peculiarity of my cat was soon dispelled by experiments with a number of other cats, all of which ate green corn with equal readiness. Further

[1] Zool. garten, July, 1878, jahrg. 19, pp. 211–213.

experiments showed that brown-bread, johnny-cake, and pastry made chiefly of Indian meal, are eaten readily by cats, and that oat-meal, in its different forms, is more agreeable to them than is food which consists mostly of wheat flour. This appetite for corn explained why I had seen, a number of years ago, two half-wild kittens stealing daily the uncooked meal mixed with water and given to chickens, and it shed light on the reason for the peculiar avidity with which some cats feed upon popcorn. I had previously attributed the appetite which cats have for popcorn to the preference that they exhibit for crisp food, for food that crackles while being chewed.

It would be entertaining and instructive if some one would take advantage of the cat-shows which are held now and then in our large cities, where a considerable number of pet cats are collected together, and write out a series of notes on the strange appetites acquired by the feline race from its intimacy with man. Statements should be based upon actual experiments made in each case by the writer, and not upon the assertions of the owners of the cats. The percentage of cats that would eat corn, raisins, candy, and other substances not ordinarily eaten by cats, could be determined readily in that way.—*George Dimmock, Cambridge, Mass., March 14, 1884.*

Zoological Notes.—*Infusorians.*—Dr. A. C. Stokes describes in the *American Journal of Science* for July, several new species of infusorians from fresh water taken from the sediment at the bottom of an aquarium. *Loxodes vorax* Stokes was observed to make a choice in its food. Of the new genus Apgaria, three new species are described; of the new genus Ileonema a new species, and of the new genus Solenotus, two species are described; all are figured.

Cœlenterata.—M. Bedot has investigated the nature of the organ usually called a liver, situated between the two lamellæ that form the pneumatocyst of Velella. The principal part of the organ consists of a mass of cnidoblasts. Above this mass of cnidoblasts is a layer of small tubes closely packed together, and containing cellules, some of which are black or dark green. The less closely placed canals below the mass of cnidoblasts have but few dark grains. M. Bedot believes that this organ is that which forms the cnidoblasts, and he finds in the lower lamella of the floor of the pneumatocyst numerous openings, by which the stinging cells find their way into the ectoderm. If any part of the organ subserves the purpose of a liver, it can only be the superior portion in which the dark cellules occur.——W. K. Brooks (loc. cit) contributes some notes upon the larval forms of *Turritopsis nutricula, Cunina octonaria, Nemopsis bachei, Phortis gibbosa,* and *Amphinema apicatum,* as observed at Beaufort, N. C. The first of these remains attached to the stem for some time after

the rupture of the perisarc, and has, when set free, eight tentacles, a thin globular bell, and a simple proboscis. In examples two weeks old, the stomach is suspended some distance below the sub-umbrella by a transparent mass of large cells, and the lower surface of the wide velum is pushed out to form eight hemispherical pouches, four perradial and four interradial. *C. octonaria*, as stated by McCrady, lives in its young state as a parasite within the bell of Turritopsis. The medusa of *N. bachei* L. Ag., is derived from a fixed hydroid closely related to Bougainvillea and Eudendrium. In the simplest stage of the medusa there are four tentacles, but others bud from the same points, forming clusters. In *P. gibbosa* the medusæ escape, one at at a time, from a gonotheca containing three or four. The apical process in Amphinema is not present in the larval medusa, but commences to develop on the third day.

Worms. — A recently issued part of Semper's "Reisen im Archipel der Philippinin" contains an account of the Sipunculids by Drs. De Man, Bulow and Selenka. Seven colored plates accompany the text.——A magnificent atlas of the Rhabdocœlida, containing twenty highly finished and colored folio plates, has been issued by Dr. L. von Graff, to accompany his extensive monograph of the Turbellaria, the first part of which contains descriptions of 259 species of Rhabdocœlida.——The otocysts of *Arenicola grubii*, according to M. Et. Jourdain, are situated on the dorsal aspect in the midst of muscular fibers, and are fixed by their conjunctive envelope, which is prolonged over them and surrounds them. They are not in immediate contact with the œsophagean commissures, but are simply united to them by several nerves.

Mollusks.—Sowerby's "Thesaurus conchyliorum" has reached its forty-second part. The last issue contains monographs of Teredo and Kupheo, Gastrochæna, Fistulana, Saxicava, the Pteropoda, and numerous other genera, including Tridacna and Hippopus, the varieties of which are very fully figured.——Henri Drouet (Bailliere, Paris), has put forth a monograph of the Unionidæ of Italy, which comprise forty-three forms of Unio, six of Microcondylus, and thirty-one of Anodonta. The basin of the Po and Upper Italy is one of the richest districts in Europe with respect to this family.

Arachnids.—At a recent meeting of the Academie Royale des Sciences of Belgium, M. MacLeod gave a preliminary communication upon the anatomy of Trombidium, Argas, Hydrachna and Gamasus. The suckers of the two first genera differ considerably; it has been proved that a communication exists in Trombidium between the stomach and the terminal intestine; a powerful muscle has been found to be attached to the supposed poison glands in that genus, and the course of the excretory canals of the salivary glands has been followed. Certain granules contained in the terminal intestine of Argas are formed in special

tubes which present much analogy to the Malpighian canals of the Araneidæ described by Plateau.

Crustaceans.—E. A. Birge (Stud. from the Biol. Lab. J. Hopk. Univ., 1883), describes and figures various stages in the development of *Panopæus sayi.* The zoea moults a large number of times. In the change to the megalops stage all trace of the long spines is lost. In this it differs from Cancer, in which the megalops retains the dorsal and frontal spines. The last megalops stage is reached after at least four moultings.

Birds.—The osteology of the kingfisher (*Ceryle alcyon*) is described and well figured by Dr. Shufeldt in the *Journal of Anatomy and Physiology*, XVIII, 279. After touching upon the general characteristics of kingfishers, their distribution, mode of life, and the views of the leading authorities upon their taxonomy, he then examines the skeletons. The account is rendered a comparative one, as Alcedo is compared with Ceryle, and sometimes with Geococcyx and Coccyzus.

Mammals.—M. A. Milne-Edwards announces the discovery of a new species of Hydropotes, called by M. Hende *H. argyropus.* It is a native of Corea, and differs from *H. inermis* in the lighter color of its hair, and in some cranial characters.

PHYSIOLOGY.[1]

BIOLOGICAL ACTION OF THE SALTS CONTAINED IN SEA WATER ON THE EXISTENCE OF MARINE ANIMALS.—An essay on this subject by H. A. Coutance, has been translated and published in the last report of the U. S. Commissioner of Fish and Fisheries. Marine animals are organisms of excessive sensibility, and in their distribution are dependent on the composition of the salt water, the nature and quantity of the gases dissolved, and the temperature, force and operation of the currents. M. Coutance experimented on the common mussel, the *Venus decussata*, the common periwinkle, and the whelk, *Buccinum undatum.*

By reason of their different organization these mollusks gave very different results. The bivalves which could shut themselves up between their valves, as a general rule, showed greater resistance than the univalves. Of these the periwinkle, whose operculum can close entirely, prudently retired into the remotest coils of the spiral, and were thus better protected than the buccins, whose opening does not shut tightly, and into which the water can easily enter by the canal at the mouth of the shell.

Salts of potash seem much less favorable than the salts of magnesia, and especially than salts of soda. Life ceased first in the ioduret, the bromide, the chloride, and the sulphate of potassium, and in solution No. 10, the prevailing element of which is chloride of potassium.

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

The salts of soda and magnesia still maintained life when the animals had succumbed in the salts of potash. Solution No. 9, for instance, the principal element of which is chloride of magnesium, preserved its inhabitants alive much longer, and the same applies to the sulphate of magnesia alone, and in solution No. 11.

The resistance of the palourdes in the Vichy water shows the favorable action of salts of soda on the preservation of life in marine animals; for forty days the palourdes lived in this mineral water!

It was in the sulphate of magnesia and the sulphate of soda that life was sustained longest, the latter excelling the former. On the 12th of March I tasted some of the *Venus decussata*, which had been kept in sulphate of soda for sixty days, and found their flavor excellent and without any trace of a bitter flavor. This observation might prove useful in alimentary economy, as the palourde is a highly prized shellfish, and sulphate of soda can be bought cheap.

It is a fact worthy of remark that it was only in the solutions of sulphate of soda and sulphate of magnesia that green algæ commenced to make their appearance at the end of sixty days. The conditions favorable to marine animal life are then apt to develop vegetable life. There is nothing surprising in this parallelism, but it receives from the present circumstance a curious confirmation. One singularity appears: the solution of chloride of sodium (impure marine salt) did not sustain life as long as the solutions of salt of magnesia and sulphate of soda, and yet salt is an essential element of the sea water. This proves that the mollusks are adapted, not to pure salt, but to that peculiar mixture which constitutes the natural sea water; and that the secondary elements, as regards their quantity, play an important part. This gives us reason to suppose that the accidental modifications of the water of the sea during the different geological periods must have had a great deal to do with the extinction of various species.

The Venus remained closed in most of the solutions, the nature of which they doubtless learned to know by opening their valves a very little. Meanwhile, they occasionally put their siphons outside the shell, for instance, in the sulphate of magnesia and in the sulphate of soda. In the solution of chloride of sodium and in the sea water they had their siphons out nearly all the time.

The palourdes can live for more than a month in the air in a cool place. For about twenty days they remain shut; later they open their valves and protrude their siphons. At the least touch they draw them in and close their valves. Then comes the moment when the striped muscles which bring the valves together have no longer the strength to do this, although the smooth muscles which retain them will still do so, when one closes the valves. In all the solutions in which these mollusks have lived these same phenomena could be observed.

The weakening of the muscles showed itself first in the striped part of the adductors, which draw the valves together, and later in the smooth part of the same muscles, which held the valves artificially closed for a constantly decreasing period.

The *Venus reticulata*, or clovisses, showed the same phenomena; the order of extinction of vitality in the different solutions was the same; but these mollusks did not live as long as the preceding ones. They succumbed a month after they had been placed in the solutions, first in the salts of potash, then in the salts of magnesia, and finally in the salts of soda.

The periwinkles resisted longer than the bivalves, and showed less repugnance to the sulphate of soda, in which they lived forty days.

The great buccin succumbs much quicker, as it cannot close its shell hermetically like the periwinkles. At the end of twenty-four days it died in most of the solutions employed, especially in the salts of potash. Its life was prolonged forty-eight hours in solution No. 12, in the sulphate of magnesia, and in the sulphate of soda, but soon came to an end.

During all the time these experiments were going on, from January 10 to March 15, the palourdes and the periwinkles lived in the sea water of the laboratory, the *Venus reticulata* and the mussels not quite so long, and the buccins only a few days.

It is a very important fact, to which we direct special attention, that the salts which constitute the sea water and the different solutions which we employed gave to the water the faculty of dissolving variable quantities of atmospheric air. We proved by direct experiments that the solutions of salts of soda retain more air when agitated by it than the solutions of salts of potash. This would, therefore, prove that the poisonous character of the salts mentioned in our experiments is caused in part by the circumstance that they do not let their solutions become sufficiently aërated; their action produced asphyxia. This explains why the sulphate of potash and the sulphate of soda, neutral salts to which the mollusks are by no means adapted, act so differently upon them, the salts of potash killing them quickly and the salts of soda preserving them for some time.

From these experiments the following conclusions have been reached:

1. The saline elements of the sea water act very differently on mollusks.

2. Every modification in the composition of the sea water finally becomes fatal to the life of these animals.

3. Their greater or less resistance depends on their organization. Bivalves resist better than spiral shells, and in these two groups the results vary according to the different species.

4. Salts of potash are less favorable to the life of mollusks than

salts of magnesia, and salts of magnesia are less favorable than salts of soda.

5. Outside of the salts dissolved in sea water the sulphate of soda seems to possess a well-established preserving neutrality.

6. The death of bivalves is caused by a general weakening of the muscles.

7. As the muscles can no longer draw together or open the valves, the animal is exposed to the unfavorable or poisonous action of the element.

A NEW EXPLANATION OF THE PROCESS OF INFLAMMATION.—In the last number of the *Quarterly Journal of Microscopical Science* there is a translation of Dr. Elias Metschnikoff's paper "On the Mesodermic Phagocytes of certain Vertebrates," originally published in the *Biologischer Centralblatt.* Metschnikoff has shown elsewhere that certain amœboid cells in the tissues of the invertebrates have the power of ingesting and absorbing food particles. On experimenting with vertebrates, he found that the connective tissue cells had the same power, and that, in a batrachian larva about to metamorphose, the absorption of the tail was brought about by these cells, which he terms "phagocytes." At the beginning of the metamorphosis these amœboid connective-tissue cells collect round the muscles of the tail, and gradually devour their fibers. The fragments of muscle retain their structure for some time after ingestion, so that that process can be readily seen to take place, but gradually lose their striation and break up into rounded strongly refracting globules. In order to ascertain whether these "phagocytes" would absorb, and so eliminate from the system injurious substances, Metschnikoff injected putrescent blood, so as to induce septicæmia. In a short time the white blood corpuscles (which are also included in the term "phagocytes"), were seen to contain both still and motile bacteria, and these organisms were especially abundant in the "hæmophagocytes" or white blood corpuscles of the spleen. This fact, taken together with the probability that the spleen has no very important physiological function, since animals live without much apparent discomfort after its complete excision, seems to indicate a prophylactic function for the spleen, it being merely a protection against septic bodies such as bacteria, the removal of which from the body is its function.

To apply these facts to the process of inflammation. When inflammation was induced in the tail of a newt, the first phenomenon was the collection of connective-tissue "phagocytes" round the injured cells, followed by the passage of "hæmophagocytes" or white blood corpuscles through the walls of neighboring capillaries, both collecting apparently for the purpose of devouring and so removing the ruptured, dead and dying cells.

In fact the essence of the whole inflammatory process may be

said to be a conflict between the "phagocytes" and the septic material, whether the latter be a dead or dying cell, bacteria or other foreign body. In the invertebrates, where connective-tissue cells are abundant, the vascular system does not participate in the process, only doing so among vertebrates, where the extra-vascular "phagocytes" are not sufficiently numerous to combat the injurious structures, a call for assistance being then given to the "hæmophagocytes." The first effect of irritation is on the connective-tissue "phagocytes," the changes produced in them subsequently influencing the capillary walls, and allowing the transit of the white corpuscles.

The theory has much to recommend it, being founded on logical, *á priori* grounds, and affording simple explanations for many obscure points in connection with inflammation. For instance, it affords a simple explanation for the presence of the large numbers of connective-tissue and white blood corpuscles that have been observed in induced keratitis, and also it explains how in certain epidemic fevers—famine-fever for instance—numerous sprilla, etc., can exist in the blood of as yet unaffected individuals, without causing any symptoms of the epidemic. At the same time the theory is quite compatible with all definitely ascertained pathological facts, a circumstance which alone would give it considerable weight.—*Professor McMurrich, in Canada Lancet, May, 1884.*

PSYCHOLOGY.

Singular Friendship between two Birds.—During the summer of 1880, I purchased from a Chicago bird dealer a number of birds for my aviary, and in making my selections, the dealer, after considerable parley, permitted me to separate a male "African cutthroat finch" from his mate, which, with the others, some thirty birds, were shipped here. Of the number was a male white Java sparrow, whose principal occupation seemed to be the pecking and pulling out of feathers of the cutthroat finch. The separation of these two birds was the only way to have peace in the cage, but upon their being brought together the old feud was resumed. While in the cage with the rest of the birds there was but one that took any part in the conflict or attempted to shield the cutthroat, and this was an indigo finch (*P. cyanea*).

The moment that the two were placed in the one cage the Java would at once fly upon the frightened finch and nearly kill him, and he would rush from one side of the cage to the other, eagerly trying to find some place of retreat; perhaps behind some other bird, but only for the moment, for the vicious Java would drive him from his shelter to again chase him to his heart's content.

In the meantime I ordered more birds, a mate for the Java and a number of finches from Africa and other countries, and upon their arrival the experiment of watching their reception by the

birds of the avairy was at once proceeded with. The heretofore abused cutthroat was also placed in with the rest.

Immediately upon his entrance his former manner was changed, and so suddenly, as if by magic. His former expression denoting fear was now abandoned, and the little fellow, with all the sprightliness of the monarch of the aviary, a flit of his wings, a chirp, and he was by the side of a small finch I had not as yet identified. The new-comer was crouched upon the floor of the cage, in fear, and partly perhaps through exhaustion.

It was at once evident that these birds were friends, for there was a caressing of bills, a few notes from the bird, which proved to be a female cutthroat finch, and an apparent communication between them, yet with all their apparent pleasure there was something that made the male cutthroat utter a savage cry, almost a shriek, and away he darted from the side of his restored mate and straightway he attacked the newly arrived Java sparrow. From side to side of the cage they flew, he in hot pursuit; at last he mounted upon her back and with fearful strokes pulled away at her feathers, on the side of her head and neck. The Java uttered tones of pain, but the cutthroat was upon the war-path, avenging the wrong done his former companion. The other birds flew wildly to the top and sides of the cage, seeking shelter from the savage little finch, so suddenly become a monarch. A day before and but one friend did this little outcast have in all the inhabitants of this large cage, and this one the lonely indigo finch. At last the male Java sparrow, the tyrant, went to the rescue of the newcomer of like species; but what a change came over the ruler of that cage, when the cutthroat, with a wild harsh cry, flew upon his assailant and catching him by the lores pulled away like a bull-dog. Another change of position and the finch was upon the sparrow's back, and away they both went, to all parts of the cage, the little one keeping his hold, while each of the other occupants excepting the female cutthroat and indigo finch sought refuge by clinging to the top and sides of the cage, as far as possible from the scene of action. Even a Baltimore oriole that had many times taken pleasure in pecking his sharp bill at the helpless cutthroat, now sought refuge, and even more eagerly than the smaller birds. At last the female cutthroat chirped more loudly than before, and though in the heat of the battle the little mate left his abuse of the sparrow and flew to her side.

At this procedure there was some hurried chirping and instantly the male hopped over to the opposite side of his crouched mate. Then with his bill he laid aside the feathers of her wing, pushing his bill well up into her feathers, thence hurriedly withdrawing, another cry, and once more, more viciously than ever, he flew at the female sparrow, starting her in wild flight before him; in his way he passed the male; at once turning he lit upon him as if to chew him up. Thus did the battle continue for some time until the sparrows were exhausted.

And strange to say that while this last scene was being enacted in the aviary, the indigo finch went to the side of the wounded bird as if to be of greater security, which was needed during the bird's indisposition.

Such was the change in this motley flock of birds, that all but the indigo finch and the female cutthroat feared her mate.

For fear of accident I removed the two finches, male and female, to a cage by themselves, where they remained for some days, when at last the female died from injuries sustained, as I believe, through the attacks of the female Java sparrow while the birds were en-route from Chicago here.

After her death, I again placed the disconsolate mate back into the large cage where, for many weeks, no song was heard from him, and at anytime one could witness the two friends, the indigo and cutthroat finches, sitting as closely as possible to each other upon the perch, and as far as possible from the other birds.

And again, many times did I permit the door of their cage to be left open that all the birds might fly about in a large room if they so wished, and in every instance one of these friends did not leave the cage without the other one following, and when tired of flying about they would nestle together, side by side, upon some picture frame and there in mutual sympathy commune by thought as one.

Truly these were friends and their sympathies went out to console one another. There was no more fighting in this cage and though a long time passed before a song was heard from the affected mate, when it did come it was but a feeble melancholy ditty.

Several of the birds in this cage were kept together for nearly two years, of the number, the four above referred to, and in all that time there was no more fighting nor was there any lack of friendship between the two bird friends referred to here.

At last, when I found I could no longer care for my birds as I ought to, they were forwarded to St. Louis, Mo., and though some died upon the way, I believe the most of them are at this day in the Zoölogical Gardens of that city.—*D. H. Talbot, Sioux City, Iowa.*

Filial Affection in a Horse.—M. Briot, chief engineer of the province of Scutari, Turkey, sends the following to the *Révue Scientifique*. A band of Albanian mountaineers, with their flocks, cattle and horses, arrived at the Drin when that river was swollen by a freshet. To cross in the only boat at hand would have taken twenty-four hours at least, so they tried to force the animals to swim. About twenty horses, including five or six mares with their foals, were at length driven into the water. All crossed safely except one old mare laden with an enormous burden. Gradually forced downwards by the current, she seemed to give up the struggle. But while the other foals were prancing joyously around

their mothers on the opposite bank, one ran around neighing sorrowfully. Soon this foal of three months came to the bank, and, gazing over the stream, perceived his mother, who was already carried some thousand feet down stream. With a piercing, indescribable cry, and a prodigious bound, he sprang into the water. For an instant he disappeared, then came into sight swimming vigorously towards his parent. Unable to see her for the waves, the young creature, who just before had feared to enter the water, sprang forward by bounds with outstretched neck, neighing at each bound. The mother heard and responded, raised her head and seemed again to care for life. The foal reached its mother, allowed her head to rest on his shoulder as he swam towards shore, and succeeded in saving her. "The horses here have more moral sense than the people," says M. Briot. He who reads the daily papers will be likely to come to the same conclusion as regards other countries than Albania.

ANTHROPOLOGY.[1]

BUREAU OF ETHNOLOGY.—The second annual report of the Bureau of Ethnology to the secretary of the Smithsonian Institution, 1880–'81, by J. W. Powell, director, is just issuing from the Government press, bearing the date 1883. The volume will be uniform in appearance with the first, and will contain XXXVII—about 500 pages, 77 plates, 714 figures and 2 maps. The following is the table of contents:

The editorial work on the volume has been in charge of Mr. James C. Pilling, and the reader will feel his obligation to him on every page.

The report of the director is devoted mainly to an account of the operations of the bureau and to abstracts of the papers in the appendix. "The investigations," says Major Powell, "have been pursued in the four great departments of objective human activities, viz., arts, institutions, languages and opinions. The facts in each field of research throw such light upon each other field that one cannot be neglected without injury to the others." The work of the bureau is carried on mainly by specialists in its employ, but collaborators in all parts of the country assist in many ways.

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

In addition to the monographs published in the annual report, works of larger range are in preparation for the series of contributions by Dorsey, Gatschet, Riggs, Pilling, Smith and Mason. Field work is reported by Henshaw, Hinman, MacCauley, Smith, Cushing and Stevenson. The following brief abstracts will give some notion of the papers above mentioned:

Since 1879 Mr. Cushing has been a member of the Zuñi tribe of Indians. No other individual in our time has enjoyed greater advantages of becoming familiar with the inner life of savagery.

The Zuñis suppose the sun, moon and stars, the sky, earth and sea, plants, animals and men to belong to one great system of all conscious and interrelated life, in which the degrees of relationship seem to be determined largely, if not wholly, by the degrees of intimacy. It naturally follows that worship relates especially to animals, more nearly related to man than are the remote powers of nature, yet more nearly related to these powers than to himself. Zuñi fetichism seems to have arisen from these relationships. The use of fetiches is chiefly connected with the chase, and the six prey gods are the mountain lion, the bear, the badger, the wolf, the eagle and the mole, answering to the four points of the compass, the upper and the under world. The Zuñi Iliad preserves in archaic phraseology the body of this mythology. It is impossible here to repeat any of the charming myths, which must be read in full to be enjoyed at all. We call the attention of archæologists to the constant presence of the arrow point in the wrappings of the gods and also to what is said about gashes in arrow-shafts on page 10.

Mrs. Smith pursues the same line of study as Mr. Cushing, and having spent much time in the tribes of the Iroquois stock, has been able to collect many new myths. The remarks of the author with reference to a belief in the "Great Spirit" and to the Hiawatha myth are of great importance. Hinu, the beneficent thunder god, holds a conspicuous place in the Iroquois pantheon. Next to him stand the West Wind, the North Wind, Echo and the Great Heads. Atotarho and Hiawatha are classed as demigods. The stories of the stone giants are full of interest, as are also those relating to the pigmies. In the chapter on sorcery the author enumerates the varieties of incantation. Chapter IV relates to the origin of phenomena, to which study Major Powell has given the name of savage philosophy; and chapter V is a collection of stories. Chapter VI closes this most interesting production with a brief discussion of religion.

Mr. Henshaw, an accomplished zoölogist, examines carefully the products of handicraft belonging to the Mound-builders, in order if possible to identify the species. The following are his conclusions:

"That of the carvings from the mounds which can be identified there are no representations of birds or animals not indigenous to the Mississippi valley.

"That a large majority of the carvings possess only the most general resemblance to the birds and animals of the region they were doubtless intended to represent.

"That there is no reason for believing that the masks and sculptures of human faces are more correct likenesses than are the animal carvings.

"That the state of art-culture reached by the Mound-builders, as illustrated by their carvings, has been greatly overestimated."

Just as, at a hurdle race, the crowds gather at the wickets to see the horses make the leaps, so the archæologists will be anxious to know how Mr. Henshaw gets over some of our archæological hedges and ditches. Well, the first animal to block the way is the manatee, and all will agree that the leap is effective. The next myth attacked is that relating to the toucan, and what is left of it "is easy of identification. The bird is a common crow or a raven, and is one of the most happily executed of the avian sculptures." The paroquet is treated more kindly, this species having abounded in the Mississippi valley; but the particular paroquet of Squier and Davis is made to step aside. Passing over the remarks upon various well-known forms and the skill shown in the carving, we come to Mr. Henshaw's attack on the elephant mound, concerning which he doubts whether an effigy without ears, tail, tusks or extended trunk can stand for a mastodon. The author throws discredit on the authenticity of the elephant pipes.

This is a very important contribution to archæology. The author depreciates too much the skill of the Mound-builders, but his work is exceedingly timely and will cause a thorough review of Squier and Davis's work.

Dr. Matthews is already well known to anthropologists through his linguistic studies, and in the paper before us gives a charming sketch of the processes, implements, and productions of the silversmiths among the Navajos. Nothing in all the volume will be read with more pleasure by those who realize that the adoption of new methods among savages, like the unfolding of the embryo, discloses the very life history of civilization.

Mr. Holmes's monograph is a masterpiece. Commencing with the simplest uses of shells among the aborigines for vessels, spoons, celts, cutlery and scraping implements, weapons, agricultural tools; proceeding to consider their employment in ornament as pins, beads, pendants and wampum; he at last brings us to his chapters on the gorgets, where he displays his utmost skill as an artist. The chapter on gorgets is an enlargement of the paper on the same subject printed in the transactions of the Anthropological Society of Washington, Vol. II. The forms discussed and illustrated are the cross, the scalloped disk, the bird, the spider, the serpent, the human face, the human figure. It seems almost aggravating that in the same volume wherein Mr. Henshaw

and effectually disproves the Mexican origin of many animal forms in the mound-pipes, new forms should be described, concerning which the author says that they "must be the offspring of the same beliefs and customs and the same culture of the arts of Mexico."

The last two papers are by Col. James Stevenson. In them are minutely described and profusely illustrated his four thousand specimens of stone implements, clay vessels, and objects made from vegetal substances, collected in Zuñi, Wolpi, Laguna, Acoma, Cochiti, Santo Domingo, Tesuke, Santa Clara, San Juan, Cañon de Chelly, Cuyamunque, Nambé, Pojuaque, Jémez, Silla, Santa Ana, Sandia, San Ildefonso, and from Taos. An excellent map, locating the Pueblos, both ancient and modern, accompanies the paper.

To the archæologist this collection will have great value, but it will still more impress the student of the unfolding of culture. The curious blending of old ideas with new ones is everywhere manifested, and the enormous amount of material will furnish data for sound comparisons.

Anthropologists will thank Major Powell very heartily for this volume and wish that the one for 1881–'82 will not be long delayed.

ARCHÆOLOGICAL CIRCULAR.—Dr. Charles Rau has just published in the Proceedings of the National Museum for 1883, an appendix relative to contributions of aboriginal antiquities to the United States National Museum. This publication is very timely, for, notwithstanding the growing avarice for relics, the Smithsonian Institution has a warm place in the affections of many people, and constantly receives donations of aboriginal antiquities. Those who collect relics to sell care nothing about the environments, so that their specimens are comparatively worthless. On the other hand, those who donate their treasures to a public institution wish to invest them with all the value possible. Now it is to just such patrons of science that Dr. Rau has addressed his circular, advising them how to proceed in every case.

THE AMERICAN ANTIQUARIAN.—The third number of Vol. VI of this standard periodical contains the following papers:

The Bridges of Ancient Rome. By F. C. Roberts.
Ancient Mexican and Cent. American Codices and Inscriptions. By Cyrus Thomas.
Lectures on Polytheism, II. By F. G. Fleay.
Translations of the Obelisk in New York. By A. C. Merriam.
Sioux Folk-lore and Mythology. By J. Owen Dorsey.
Emblematic Mounds. By S. D. Peet.

As usual, the correspondence and notes are of great value.

The editorial article of the present number is upon relic-hunting *versus* archæological survey. The NATURALIST has always strenuously held that the most rigid scrutiny by accomplished observers should accompany every archæological investigation. Without any knowledge of the merits of the present case, the

writer of this note earnestly implores all concerned to examine cautiously their ground before hurrying onward. Perhaps Mr. Peet is a little too fond of the old explorers and a little to hard on Mr. Thomas and Mr. Carr. However that may be, it can do no harm to put the gentlemen on their guard.

PEABODY MUSEUM.—The 16th and 17th annual reports of the trustees of the Peabody Museum, forming Nos. 3 and 4, of Vol. III, contains the following anthropological papers:

Report of the Curator.
List of Additions to the Museum and Library.
Social and Political Position of Women among the Huron Iroquois Tribes. By Lucien Carr, Assistant Curator.
Human Remains from Caves in Coahuila, Mex. By C. A. Studley.
The White Buffalo Festival of the Uncpapas. By Alice C. Fletcher.
The Elk Mystery of the Ogallala. By Alice C. Fletcher.
Ceremony of the Four Winds by the Santee Sioux. By Alice C. Fletcher.
The Shadow or Ghost Lodge; an Ogallala Ceremony. By Alice C. Fletcher.
The Pipe Dance of the Omahas. By Alice C. Fletcher.
XVIIth Report of the Curator, with lists of additions.
Report on Meteoric Iron from Mounds, etc. By L. P. Kinnicutt, Ph.D.

The report of the curator is one of his best, dwelling with special fullness on his explorations in the mounds at Madisonville, Ohio. With reference to the large mounds near cemeteries the author is led to suspect that they are simple monuments marking burial sites. The spool-shaped copper ornaments found in collections are identified as earrings. But the most notable revelation is that with reference to the discovery of wrought meteoric iron. This may lead to the revision of some late discoveries.

Mr. Carr, having examined the literature of the subject, comes to the conclusion that "the Indian woman was not the overworked drudge she is usually represented to have been."

The most fascinating part of the report is that containing the papers of Miss Fletcher. A young woman of rare intelligence, filled with benevolence, and thristing for knowledge, lives for two years in the wigwams of the Omahas and Sioux for the double purpose of doing them good and of learning their social condition. We have no doubt she was successful in the former, we are certain of her complete success in the latter. Indeed, some of the rites mentioned in Miss Fletcher's papers are for the first time described and illustrated.

The long lists of donations and accessions to the collection show how complete has been the success of the Peabody Museum.

MICROSCOPY AND HISTOLOGY.[1]

MOUNTING AND PHOTOGRAPHING SECTIONS OF CENTRAL NERVOUS SYSTEM OF REPTILES AND BATRACHIANS.—Dr. J. J. Mason describes the methods he employed in mounting the sections from which the plates illustrating his book[2] were "artotyped."

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.

[2] Minute Structure of the Central Nervous System of certain Reptiles and Batrachians of America, 1879, 1882. cf. III, p. 910.

Both the brain and spinal cord were entirely separated from the body, and, with their membranes, placed in iodine-tinted alcohol until they had acquired a slight degree of consistency—from six to twelve hours. They were then transferred to a 3: 100 solution of bichromate of potash, with a small piece of camphor, in a tightly-corked wide-mouthed bottle, and allowed to remain until ready for cutting, renewing the solution every two weeks.

The time required for the hardening process varies considerably in different animals, and this variation is more dependent upon the class of animal, than upon the relative dimensions of the specimens.

For example, on the same day I placed the brain of a large rattlesnake with that of a small salamander in the same bottle, and at the end of six weeks the former was ready for section, whilst the latter was not sufficiently hard until a month afterwards. By thus employing the same reagent in all cases, I have been able to note constant differences in the action of both the hardening and the coloring agent, carmine.

Perhaps the most striking illustration of this is furnished by the nervous centers of tailed batrachians, which, while they stain very readily, invariably require about a third more time to harden than specimens from the other orders. Specimens from ophidians stain less satisfactorily than those from any other of the classes which I have studied, while with the spinal cords of alligators, turtles, and frogs, failure to obtain good results in this particular is very rare.

In all cases the sections have been stained after cutting, injury from excessive handling being wholly avoided by the use of siphon tubes to remove the alcohol and washings. For producing transparency, oil of cloves has been used, and the mounting has been done under thin, clear covers, in a solution of Canada balsam in chloroform.

All the negatives have been made on glass thoroughly cleaned and lightly coated with a solution of wax and benzole, so that the collodion film, previously made adherent to thin sheets of gelatine, could be safely removed from the plate. The flexible negatives thus obtained are well adapted to the artotype process, and, as they can be indefinitely preserved between the leaves of an ordinary scrap-book, are very desirable for a series of illustrations. In making the original negatives on glass, the 'wet collodion process,' with the sulphate of iron developer, has been exclusively employed.

The prints correspond exactly with the negatives, both in outline and detail. No distinction occurs as in silver printing in which process the paper is subjected to prolonged washing.

In many of the photographs the gray substance appears lighter in shade than the white substance. This appearance is due to a greater degree of transparency of the gray substance in these sec-

tions, resulting from the action of the oil of cloves, followed by an increased action of the transmitted light on the sensitive collodion film of the negative, and hence by a thinner deposit of ink over corresponding parts of the positive plates from which the artotypes are printed.

With regard to the process employed, Dr. Mason says that after experimenting with various methods he found that satisfactory prints could be made in ink directly upon plate-paper, and that these impressions were as perfect in fine detail as any of those obtained by the silver process of printing. The plates (all printed by the artotype process), are as durable as steel-engravings. While a photograph cannot often show all that can be discovered by more direct microscopic observation with a judicious working of the fine adjustment, high authority has stated, and perhaps correctly, that a good photograph with a low power, say from three to one-half inch, is a better means of illustrating the anatomical structure of the nervous tissues than hand-drawing. Some of the plates with high powers leave much to be desired both in distinctness and tone, and in general it may be affirmed that the same defect as regards distinctness always exists, and for obvious reasons, in photographs of sections with powers much above one-half inch.—*Jour. Roy. Mic. Soc.*, IV, *part I, pp. 149, 150.*

A STARCH INJECTION MASS.[1]—"A coarse injection mass which is cold-flowing, may be forced nearly to the capillaries, rapidly hardens after injection, leaves the vessels flexible, does not dull dissecting instruments, is suitable for permanent dry or alcoholic preparations, is simple in its manipulation, cleanly and economical, seems to be fully realized in the starch mass introduced by Ad. Pansch, of Kiel, and since recommended, with various modifications, by Wikszemski, Dalla Rossa, Meyer, and Browning.[2]

As starch is insoluble in alcohol and cold water, it becomes hard when injected into the blood-vessels simply by the exudation of the liquid with which it is mixed. (That the starch grains forming the mass remain entirely unchanged may be easily demonstrated by making a microscopic examination of the contents of an injected vessel.)

The mass originally recommended by Pansch consisted of wheat-flour and cold water, to which was added a sufficient quantity of the desired coloring matter. Later experiments have shown that pure starch is better than flour.

[1] By Professor S. H. Gage.

[2] See Ad. Panch, "Archiv. für Anatomie und Entwickl.," 1877, pp. 480–482, and 1881, pp. 76–78; Wikszemski, same Journal, 1880, pp. 232–234; Dalla Rossa, same, pp. 371–377; Herm. von Meyer, same, 1882, pp. 60, 61, and 1883, pp. 265, 266; Browning, "Annals of Anatomy and Surgery," 1884, pp. 24, 25.

MASS FOR ORDINARY INJECTIONS.

Dry starch ("laundry" is good)	1	vol.
2½ per cent aqueous solution of chloral hydrate	1	"
95 per cent. alcohol[1]	¼	"
Color	¼	"

Since almost any animal injected may afford some organ worth preserving, it seems better to employ permanent colors for tingeing the mass. Among those which are available, probably vermilion, red lead, ultramarine, chrome orange, yellow, or green, are preferable.

PREPARATION OF THE COLOR.

Dry color	1	vol.
Glycerine	1	"
95 per cent alcohol	1	"

To avoid lumps, which would clog the cannulæ, or small vessels, the color is thoroughly ground with the liquid in a mortar. It is stored in a well-stoppered bottle, and is prepared for use simply by shaking.

Special Mass.—For the injection of brains, and, perhaps, for other rapidly perishing specimens, it seems best, as suggested by Professor Wilder, to use strong preservatives in preparing the mass:

Corn starch (that used for food)	1	vol.
5 per cent aqueous solution of chloral hydrate	½	"
95 per cent alcohol	¾	"
Color	¼	"

For convenience and economy, a considerable quantity of either of the masses described above may be prepared at once, and kept in a wide-mouthed specimen or fruit jar. A smooth stick in each jar is convenient for stirring the mass, which should always be done just before using. The syringe may be filled directly from the jar, and any mass remaining in the syringe after the injection is finished may be returned to the jar.

If it is desired to have the mass enter very fine vessels, some of the stock mass, as given above, diluted with an equal volume of water or chloral solution, may be injected first, and immediately followed by the undiluted mass, or, for large animals, a mass containing twice the usual amount of starch. In whatever form the starch is used, it is necessary to work somewhat expeditiously, because the exudation of the liquid in the smaller vessels takes place so rapidly that the mass hardens very quickly in them. The larger the vessel, the more slowly, of course, do the exudation and, consequently, the hardening take place. It sometimes happens that large vessels, like the aorta, are not fully distended after the exudation of the liquid. In this case some mass containing double the ordinary amount of starch can be advantageously injected in two hours or longer after the first injection.

[1] The chloral and alcohol prevent fermentation in the mass when it is kept in stock; the alcohol also increases the fluidity and likewise the more rapid hardening in the vessels; both, of course, act as a preservative upon the animal injected.

Dry Preparations.—Finally, if vessels injected with the starch mass are dissected free, soaked a day or two in Wickersheimer's preservative, and then dried, they retain their form, and, to a great degree, their flexibility.—*From the New York Medical Journal, June 7, 1884.*

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SCIENTIFIC NEWS.

— The Paris Museum of Natural History.—We are accustomed to think that they do things better in France, yet it appears that the troubles which beset American museums are not unknown there. The total sum annually at the disposal of the Muséum d'Histoire Naturelle is but 918,942 francs, or about $180,000. Out of this nineteen professors, fifty-six assistants and a great number of gardeners, draughtsmen, librarians, clerks, secretaries, curators, laboratory helps, etc., as well as the entire cost of maintaining the Jardin des Plantes, with its conservatories and menagerie, have to be paid. Thus, according to M. Freney's report there are no laboratories for the chairs of botany, geology, mineralogy or comparative pathology; only 40,000 francs are available for the purchase of animals; the new zoölogical galleries are unfurnished; there is no botanical gallery, though there is a considerable botanical collection; there are no available funds for the utilization of the ground that has been acquired in the Bois de Vincennes for the purposes of culture; there is no marine zoölogical station attached specially to the museum; the galleries of palæontology and anatomy need improvements; an additional assistant is required to classify the insects and crustacea, and another for the annelids, mollusks and zoöphytes; and the anthropological gallery and library need enlargement. The library has 100,000 volumes, while the gallery which contains it was built to receive 30,000. Moreover, some of the aides-naturalistes ought to have superior positions opened to them, for, as occurs elsewhere, men desert the pursuit of natural history because of the insufficient remuneration it affords.

— A cable despatch announces the death in Vienna, of Ferdinand Von Hochstetter, the noted German traveler and geologist. Herr Hochstetter was born at Esslingen, April 30, 1829. He was the son of a learned clergyman, who designed him for the same profession, but after having taken a course of theology at Tubingen, and received the degree of doctor of philosophy, Ferdinand went to Vienna in 1853, and the following year became attached, in the position of geologist, to a scientific commission sent to Bohemia. On his return he was made professor of geology in the Vienna University, and in 1856 he accepted an offer to accompany the *Novara*, in the capacity of geologist, on the expedition around the world. On his return from this expedition he was made professor of mineralogy and geology in the Polytechnic Institute of Vienna. He afterwards made several voyages, and

gathered many important and interesting data, in Switzerland and Italy in 1863, European Turkey in 1869, and in Russia and the Ural mountains in 1872. Herr Von Hochstetter was elected president of the Vienna Geographical Society in 1866, and a member of the Academy of Sciences in 1870. He became intendant of the Vienna Museum of Natural History in 1876. Among his works are "Carlsbad, a Geological Study," "The Mammoth Fossil Birds of New Zealand," "The Geology of New Zealand," "The Palæontology of New Zealand," "A Voyage in Roumania," "The Geology of the Eastern Part of Turkey in Europe," and "Across the Urals."

— The distinguished Danish entomologist, Professor J. C. Schiödte, died at Copenhagen early in June, aged sixty-nine years. He was the author of a beautifully illustrated essay on the mouth-parts of certain Isopod Crustacea, and especially of numerous memoirs on the transformations of the Coleoptera, published in successive volumes of the zoölogical journal which he so carefully edited. This is the continuation of Kroyer's *Naturhisktorisk Tidsskrift*, and for the value of its contents and the beauty of its copper and steel plates, is second, perhaps, to scarcely any other periodical published in Europe, unless we of course except the *Zeitschrift für wissenschaftliche Zoologie*. We had the pleasure, in 1872, of visiting Professor Schiödte, then in charge of the entomological department of the Royal Zoölogical Museum of Copenhagen, and well remember the superb collection illustrating the transformation of beetles which he had amassed. In his death entomology loses one of its most careful and able students.

— Dr. W. K. Brooks writes us concerning the statement in the June NATURALIST that the Annisquam laboratory is the only marine zoölogical laboratory which is now open to the public in America, that the marine laboratory of the Johns Hopkins University has for six years been open to all qualified persons. "I send you a copy of the last annual report of the president which contains an appendix from which you will see that many students from various parts of the world have made use of it." We should have added that we had reference to beginners rather than advanced students, supposing that the Johns Hopkins University School was open to the latter alone.—EDS.

— In an article entitled "Pile-dwellings on hill-tops" in *Nature* for June 19, Mr. S. E. Peale gives a new and rather prosaic cause or reason for building houses on piles, *i. e.* "the absolute necessity of keeping out of reach of the ever-present pig!" This applies to the hill-tribes of Assam and vicinity; these pile-builders having probably descended from the pre-Aryans of the plains from Assam to the Indus. There is no building-stone where the piles are used.

— Through the efforts of M. Marion, the mayor and municipal

council of Marseilles have decided upon the publication of the Annals of the Marseilles Museum of Natural History, and have established a marine zoölogical station at Eudoume Point. This establishment, devoted to the study of the Mediterranean deep sea fauna, will have an underground aquarium, protected from the abrupt changes of light and temperature.

— The report of the National Academy of Sciences, for the year 1883, has been issued by the Government Printing Office. Appendix D is a list of official reports made to the Government by the academy, and of scientific papers presented to the academy from 1863 to 1883. Succeeding appendixes contain reports on methylated spirits and on glucose.

— Bulletin No. 20 of the U. S. National Museum is devoted to a list of the published writings of Professor S. F. Baird. The number of articles is 1063, including the notices, abstracts and reviews in *Harper's Magazine*, *Harper's Weekly*, and reprinted in their Annual Record of Science and Industry.

— The death of Dr. G. von Boguslawski, known as a geographer and hydrographer, occurred in June. Professor J. H. R. Goeppert, well known for his works on fossil plants, died at Breslau, May 18. Professor Schoedler, author of "Buch der Natur," died at Mainz, April 27.

— Among recent deaths is that of H. G. Vennor in June last, at the age of forty-three. He published a useful work on the birds of prey of Canada, and was connected with the Canadian Geological Survey. He was popularly known by his attempts at "weather prophecy."

— M. Fournier, a French botanist, recently died, leaving his "Flora of Mexico," which he was preparing for the French government, and that of Brazil, which he was collecting for the emperor, unfinished.

— The fifth annual report of the curator (Edward T. Nelson) of the museum of the Ohio Wesleyan University, shows that the curator's usual activity has been manifested in increasing, labeling, and arranging the collections, particularly of shells.

— At the last session Congress appropriated $501,470 for the U. S. Coast Survey; $467,700 for the U. S. Geological Survey; $244,500 for the U. S. Fish Commission, and $149,500 for the National Museum.

— The palæontological expedition of Princeton College is this year exploring the Eocene basin of the Big Horn under direction of Professor W. B. Scott.

— Professor H. C. Lewis gave field instruction to a large class near the water-gap of the Delaware river, Pennsylvania, this summer.

— Dr. H. E. Sauvage, of the Jardin des Plantes, has been appointed director of the Agricultural Station at Boulogne-sur-Mer.

—Professor O. A. Derby is successfully exploring the geology of Brazil.